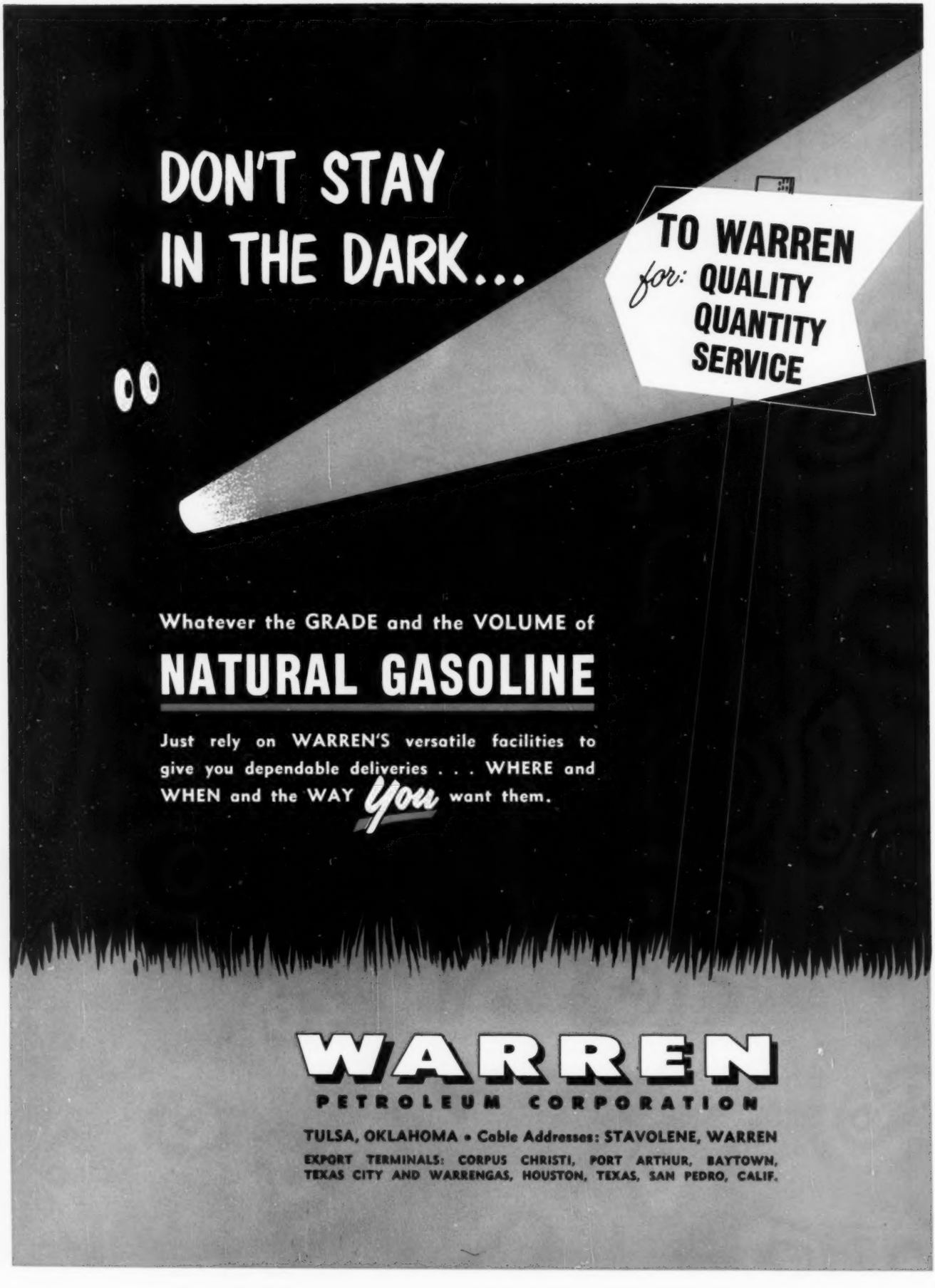
World Petroleum

MARCH 1957

TEN DOLLARS PER YEAR
ONE DOLLAR PER COPY

TABLE OF CONTENTS PAGE 45



Whatever the GRADE and the VOLUME of

NATURAL GASOLINE

Just rely on WARREN'S versatile facilities to give you dependable deliveries . . . WHERE and WHEN and the WAY *you* want them.

WARREN

PETROLEUM CORPORATION

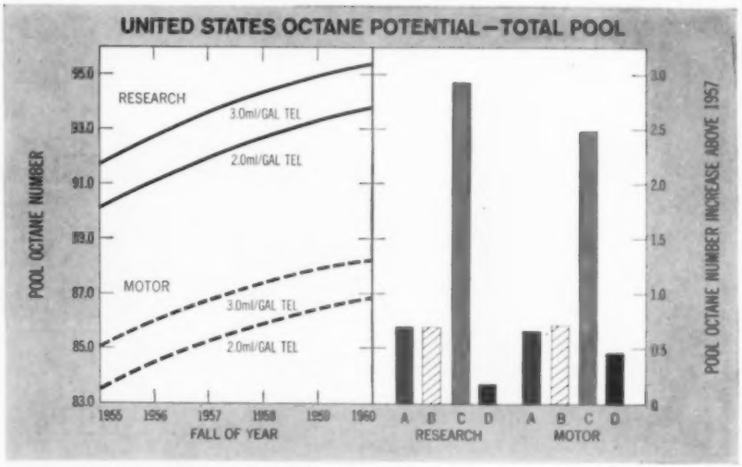
TULSA, OKLAHOMA • Cable Addresses: STAVOLENE, WARREN

EXPORT TERMINALS: CORPUS CHRISTI, PORT ARTHUR, BAYTOWN, TEXAS CITY AND WARRENGAS, HOUSTON, TEXAS, SAN PEDRO, CALIF.

ETHYL STUDY ANALYZES INDUSTRY OCTANE POTENTIAL TO 1960

New report can help in your future refining plans

by **C. J. WOLF**, Ethyl Corporation Refinery Technologist



The weighted regional-pool octane number potentials of total U. S. pool gasoline are shown from 1955 to 1960. The maximum octane increases obtainable from: **A.** increased reforming severity, **B.** reforming heavy thermal naphtha, **C.** aromatic extraction and reforming raffinate from straight run charge, and **D.** maximum alkylation are shown for the total U. S. gasoline pool. The weighted proportions of these refinery processes in use after 1957 were calculated from projected refinery economics.

Ethyl Corporation has undertaken this study to evaluate the effects of present and future refinery processes on the antiknock quality of the motor-gasoline pool in the United States.

The octane potential of the United States refining industry from 1955 to 1960 has been analyzed for the United States as a whole and, separately, for the various regions—East, Midwest, Gulf, Rocky Mountain, and West Coast. The effects of present and future refinery processes in general, and the catalytic reforming process in particular, have been the primary variables evaluated.

Secondarily, changes in crude type, the ratio of domestic-to-foreign crude run, and the composition and disposition of those products from petroleum that influence the quality and yield of gasoline have also been taken into account.

Influence of refining techniques

ETHYL studies indicate that the octane number of the total motor-gasoline pool in the United States increased by 0.9 Research octane number (RON) and by 0.8 Motor octane number (MON) from the fall of 1955 to the fall of 1956.

During this period, the portion of the U.S. refining industry utilizing catalytic reforming increased from 66 to 81 per cent (based on projected crude-running capacity). Total catalytic-reforming capacity, including spare capacity, increased from 10.6 per cent of crude run in 1955 to 12.9 in 1956.

Industry saturation of catalytic reforming in this country as a whole has been estimated at 16.0 per cent of crude run. This saturation is for virgin-naphtha feed only, and it is estimated that it will be reached in the fall of 1957.

Saturation of catalytic reforming is expected to take place by this time in all regions of the U.S. except in the Rocky Mountain region, where saturation is forecast for the fall of 1958.

The octane potential after the fall of 1957 will primarily be influenced by the severity of catalytic reforming, catalytic reforming of heavy thermal naphtha, aromatic extraction with raffinate recycle, and maximum use of alkylation for motor fuel after compliance with aviation-gasoline demand.

A summary of the catalytic-reforming growth in the United States is presented in the table below.

The effects of the growth or decline of refinery processes other than catalytic reforming during the 1955-1960 period have also been evaluated in this study. Growth is expected in catalytic cracking, catalytic polymerization, and alkylation in terms of percentage of crude run during this period. In the same terms, decline is expected in thermal operations—visbreaking, coking, and thermal cracking.

Thermal reforming, with the exception of that planned for use in conjunction with catalytic reforming, has been considered to be non-existent when saturation of catalytic reforming of virgin-naphtha is achieved in 1957.

Increases after 1957

AFTER 1957, the maximum octane increase obtainable by more severe catalytic reforming, use of reforming capacity for heavy thermal-naphtha charge, aromatic extraction and raffinate recycle, and maximum alkylation will be about 4.6 RON and 4.2 MON for the total United States.

Depending on the region, this maximum potential octane increase can range from 4.2 to 5.2 RON and from 3.8 to 5.0 MON. The amount of this maximum potential octane increase that is actually employed by 1960 will vary from region to region.

Use of the above-cited refinery processes by 1960 could increase antiknock value of the total 1957 United States pool by about 1.7 RON.

The costs of octane improvement and local area conditions will dictate relative use of these more severe refinery operations.

In general, it is felt that increasing reforming severity to average a yield of about 80 per cent debutanized reformate will be almost universally employed throughout the industry by 1960.

The use of aromatic extraction and raffinate recycle and of catalytic-reforming capacity for heavy thermal-naphtha charge will be practiced by only one-third of the industry in 1960. It is believed that use of these processes will vary between 0 and 40 per cent, depending on the region.

Maximum alkylation above and beyond that required for aviation gasoline will be practiced by about 20 per cent of the industry as a whole, and in the various regions, with the exception of the Rocky Mountain area.

CATALYTIC REFORMING

Per Cent of Crude Run

Fall of Year	1955	1956	1957
East	9.4	11.7	17.0
Midwest	11.0	13.1	16.9
Gulf	10.8	13.7	15.1
Rocky Mountain	1.9	7.2	11.9
West Coast	12.7	13.7	15.9
Total U. S.	**10.6**	**12.9**	**16.0**

HOW ETHYL RESEARCH CAN HELP YOU

To assist refiners in obtaining the most economical routes to high-octane fuels, Ethyl Research maintains a close watch on trends in refinery processing. Recent studies of crude sources, processing and product yields provide a realistic evaluation of the octane potentialities of motor gasolines. The major findings are summarized for you here. A complete report entitled "U.S. Refining Octane Potential 1955-1960" is available through your Ethyl Representative.

ETHYL CORPORATION
New York 17, N.Y.

RESEARCH LABORATORIES:
1600 W. Eight Mile Road, Ferndale 20, Mich.
2600 Cajon Road, San Bernardino, Calif.

Over
70
Locations in the United States and Canada

McCullough® REPORTS TO THE OIL INDUSTRY

Service
Anywhere Anytime

New Services • • • New Tools • • • New Methods • • • Outstanding Results

McCullough Log Picks 2' Oil Stringer in Water Bearing Formation for 80 B/D.

This well had been deepened to a total depth of 2656' and a 5" liner was run in the 7" O.D. casing. It was completed in a formation known to carry a lot of water in addition to a very thin stringer of oil sand. Extreme accuracy in logging and perforating operations was necessary to pick up and shoot the oil zone – it meant the difference between an oil well or a water well.

McCullough Gamma Ray, Neutron and Collar Logs were obtained in one run and the 2' oil zone was located and oriented in relation to casing collars and depth measurements.

Well was dry before perforating and was shot one foot at a time in two runs. A bailer was run after the first gun was fired to test the accuracy of perforating depth control and oil was recovered well above the zone. 3½" O.D. McCullough M-3 Bullet Guns were used, firing improved ½" Ogival Bullets, 6 per foot.

After the second gun was fired the well came in for 80 barrels of clean oil per day. Neither fracturing nor acidizing were required—a rarity in this field.

The operator was well pleased with the accuracy and efficiency of McCullough logging and perforating operations. Economy was an added bonus on the job – it only required 2 hours to complete both services.

YOURS . . .

New 12-page Bulletin describing McCullough Radiation Well Logging Service. Just write McCullough Tool Company, 5820 S. Alameda Street, Los Angeles 58, California. We'll send your copy by return mail.

20 Million Cubic Feet Per Day Gained By Accuracy of McCullough Log

McCullough Gamma Ray – Neutron Log Finds Previous Logging and Perforating Measurements 8 Feet in Error – Well Was Re-Completed in Plugged Off Zone For an Excellent Producer.

This well was drilled and completed in 1941 in a gas sand at 9600' – a good producer. In 1948 production had fallen off and the well was worked over. A neutron log was run by another service company, locating several potentially productive sand stringers from 8800' to 9000'. These zones were perforated and tested by the service company with no results. A bridge plug was set above these zones and the well was completed further up the hole for a fair producer.

Late in 1956 production had again fallen off and it was decided to re-work the well once more. McCullough was called on the job. A re-examination of previous logs showed that the neutron log run in 1948 by another service company differed in measurement by eight feet from the electric log run at the time of original completion in 1941. Collar locations were also in disagreement.

The bridge plug was drilled out and McCullough ran a combination Gamma Ray-Neutron Log, obtaining also a simultaneous collar log.

The six previously perforated, "non-productive" zones were located. Of these, the top four had been perforated two feet high while the bottom two had been perforated entirely out of the sands.

Quantitative analysis of the McCullough Radiation Log indicated that a 12' interval at 9002' should be productive (previous perforating had missed this sand entirely). McCullough measurements checked out with the original electric log. The zone was perforated, 6 holes per foot, through 5½" O.D. 17 lb. cemented casing by McCullough Super Casing Glass Jets in a Steel Strip Carrier.

The well is now producing 20 million cubic feet of gas and 35 barrels of distillate per day – from a zone previously classed as non-productive.

The best proof of the value of McCullough Radiation Well Logging Service, and of complete customer satisfaction, is that McCullough is now re-logging and re-perforating other wells for the operator in this field – with outstanding success!

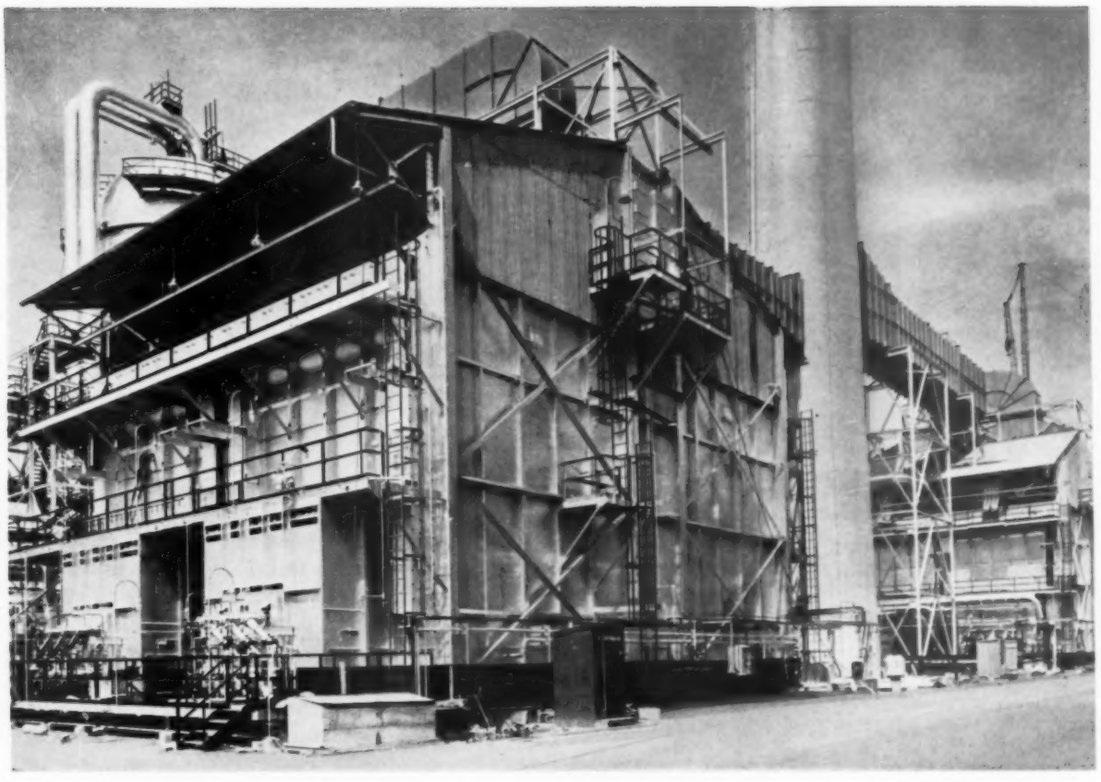
It always pays to rely on the accuracy and dependability of McCullough Radiation Well Logs.

McCullough® TOOL COMPANY

Cable Address: MACTOOL

LOS ANGELES
HOUSTON
EDMONTON

WORLD PETROLEUM FOR MARCH, 1957, Vol. 28, No. 3, March, 1957. WORLD PETROLEUM is published monthly by Mona Palmer, Trustee under the will of Russell Palmer, Emmett Street, Bristol, Conn. Editorial and Executive offices, 604 Fifth Avenue, New York 20, N. Y. Accepted as a controlled circulation publication under Section 34.64 P.L.&R. at Bristol, Conn. Subscription rate: $10.00 per year, single copies $1.00. Copyright 1957, by Mona Palmer, Trustee.



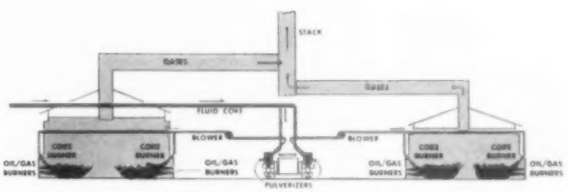
357,000,000 btu/hr

from two FW direct-fired oil heaters designed to burn FLUID COKE

SUPPLYING the heat requirements of the world's highest capacity crude distillation unit at the new ultra-modern Delaware Flying A Refinery of Tidewater Oil Company, the two Foster Wheeler direct-fired oil heaters shown above have a heat absorption capacity of 357 million btu per hr. The petroleum industry's first direct-fired heaters designed to burn fluid coke, they are capable of heating 130,000 bbl of crude per day.

Fluid coke can be burned at the rate of approximately 220 tons per day, supplying one half of the total direct heat requirements when operating at full capacity. Fuel oil or gas burning will supply the other half.

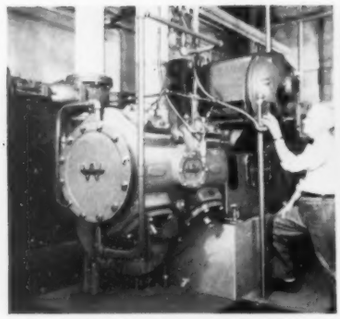
This installation is another example of Foster Wheeler's ability to design and construct direct-fired heaters of exceptionally high heat-duty requirements. This specialized



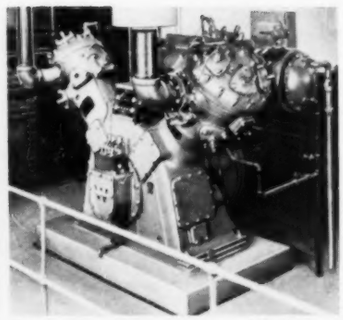
experience can help you save time and expense in meeting your exact requirements for special heating and vaporization units. For full details on the 357,000,000 btu/hr units above, send for the Nov.-Dec. Heat Engineering. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

FOSTER WHEELER

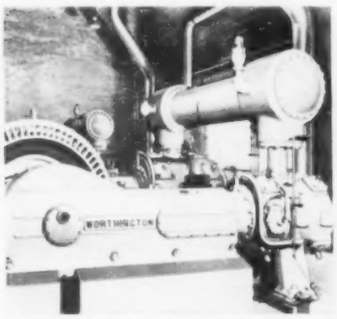
NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.



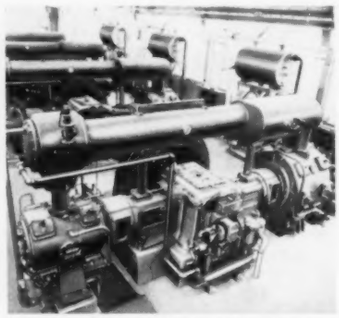
Single-stage compressor, type HB. For economical, continuous supply of air in smaller quantities. Sizes range from 10 to 125 hp. (Bulletin L-640-B1C)



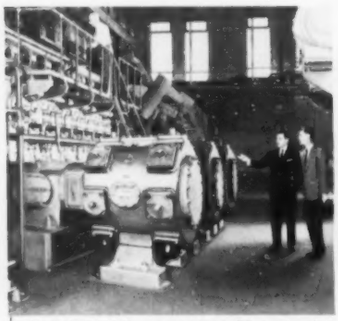
Two-stage angle compressor, type YC. Most compact unit for its capacity. Available up to 250 hp., and in larger sizes in similar type DYC. (Bulletin L-676-B1A)



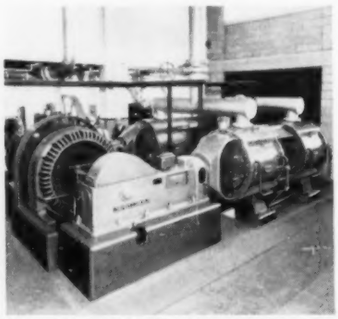
Horizontal duplex compressor, type DC-2. A two-stage compressor designed for heavy-duty service. From 250 to 3,000 hp. (Bulletin L-675-B1B)



Balanced opposed compressor, type BDC. Versatile—ideal for either multiple or single-service applications. Sizes from 300 to 10,000 hp. (Bulletin L-679-B1)



SUTC gas-engine compressor. Most complete process flow flexibility with 2-cycle compactness. Available in ratings from 750 to 2,500 hp. (Bulletin S-550-B23D)



Vacuum pump. This Worthington "compressor in reverse" provides pressures as low as .25 psi. Available in sizes from 10 through 2,500 hp. (Bulletin L-600-B9-4)

No compromising machine selection with this complete compressor line

There's a Worthington compressor and drive for *every* compressor need . . . ranging in size up to 10,000 hp; air and gas pressures to 35,000 psi. For information, see your nearest Worthington distributor, or write: Worthington Corporation, Department O.C., Harrison, N. J., U.S.A.

WORTHINGTON

The sign of value around the world

By Joseph B. Huttlinger

Humphrey Supports Depletion Allowance

For the first time in many years, a secretary of the treasury has a good word for (a) a depletion allowance for crude-oil and natural-gas production, and (b) an allowance at the level of 27.5%—which is the present level.

Secretary of the Treasury George M. Humphrey is the man. In taking this position, he supports the American oil and gas industry in a vital matter.

Under Presidents Roosevelt and Truman, secretaries of the treasury tried to eliminate the allowance or to slash it back to 15%—moves which were blocked by the Congress. Under the depletion provision, oil and gas producers take out 27.5% of their gross income, with certain limits, before calculating their income taxes. This serves to reduce the income-tax bill—thus leaving extra funds to finance the risks of oil exploration, to provide capital for new explorations, and to allow for the fact that—oil and gas wells run out, i.e., "deplete."

For years, Secretary Humphrey said he has been studying the 27.5% level. This year, in his press conference in connection with the budget of the President, he gave his findings.

" . . . it looks as if this thing was working out about practically," he said at one point. "I think, in practice, this was worked very well," he said later. But, he insisted, there is no way of making statistical proof that 27.5%, or 27⅝% is the exact figure. One way you can tell is if oil production keeps up with demand, he said.

Here is the full text of questions and answers on the subject:

Q. "Mr. Humphrey, a year ago—with reference to depletion allowance on oil—you said "proper depletion is a very proper deduction, and a very desirable one from the whole point of our economy." Do you regard, Sir, the rate of 27.5% in oil a proper rate?

Secretary Humphrey: "I don't know whether it is proper or not. That figure was arrived at after long hearings and a great deal of discussion on the subject and all sorts of evidence and proof, and the Congress finally picked out that figure. That was done before we came here.

"I had no part in those proceedings. In the way the thing worked out, our reserves of oil—our new development of oil in this country, which is continually more expensive, both searching for it and getting it after it is discovered, i.e., producing it—over the past half-dozen years or more have just

PIPE LINE

about kept pace with consumption; so that, from a practical point of view, it looks as though this thing was working out practically."

(At least one reporter was not satisfied, for he threw out another question about a half hour later—the first chance he had.)

Q. "Mr. Secretary, for several years (this is back on the depletion provision) you said you had been studying whether this 27.5% was right, and then today you said you don't know whether this is the right level, but you think it works out about right."

Secretary Humphrey: "That is right.

Q. "Could you spell that out?

Secretary Humphrey: "All I'm saying is that I don't think anybody in the world can tell you whether 27½ or 27⅝, or 27, or some other fraction is exactly right. These have to be approximations to obtain a certain objective. If you have a figure which works out to about a proper objective, that is about as close as you can come.

"The same thing is true with depreciation. You estimate the life of equipment at about so long, and you do it the best you can. You keep revising that. If the equipment changes more rapidly, why you cut it down. If it is too long, you raise it."

Q. "On this point, the Congress will ask your ideas this year, I think. Maybe there are a couple of questions in your shop now.

Secretary Humphrey: "My answer would be the same I gave you."

Q. "To stick to 27.5%."

Secretary Humphrey: "I gave you the best answer I have, I think, in practice, this has worked pretty well."

Crude petroleum production in 1956 climbed to 2,619 million barrels (a record) and 5% above the 1955 level, Secretary of the Interior Fred A. Seaton said January 19.

The value was $7,308 million at the wells, a gain of $500 million, the "greatest" gain for any mineral.

The average value is estimated, he said, at $2.79 a barrel, compared with $2.77 a barrel during 1955.

Natural-gasoline production increased 6%, he said, to 148 million barrels, valued at $429 million. Average value dropped from 7.3 cents a gallon in 1955 to 6.9 cents in 1956 "because of excess gasoline stocks accumulated during the year."

LPGas output rose 7%, to 153 million barrels, valued at $257 million, he said, and average value increased from 3.3 cents a gallon in 1955 to 4 cents in 1956.

Marketed production of natural gas is estimated at 9% over that of 1955, with a total value of $1.134 million. Average value is estimated at 11 cents per MCF.

(Continued on page 112)

Meet the **MARINER!**

New UNIT Crane for OFF-SHORE OPERATIONS!

Here is a new full-revolving, stationary-mounted crane — the UNIT Mariner — specially designed for off-shore drilling operations. Conceived, developed and perfected by UNIT, the Mariner meets all requirements for cargo handling from a fixed mounting as applied to ships, barges or off-shore platforms. Unlike conventional cranes, the Mariner emphasizes unusual strength in turntable, roller path, rollers, hook shoes, boom and hoist mechanism.

A special, heavy-duty "A" frame permits capacity loads with extended boom at long radius. The famous UNIT sealed cast gear case serves as a protection against salt spray.

SAFETY is a major feature. Incorporated in the Mariner design, are positive and mechanical boom stops. These boom stops control the angle of elevation and prevent the boom from whipping back. Also the safety-promoting Full Vision Cab enables the operator to see what he is doing at all times. Load ratings are based on high factors of safety.

Yes, the Mariner is designed primarily for your type of cargo handling. Get the facts. Send for bulletin — NOW.

UNIT CRANE & SHOVEL CORP.
6617 W. Burnham St. • Milwaukee 14, Wis., U.S.A.

UNIT CRANE & SHOVEL CORP. UNIT MILWAUKEE WISCONSIN

Geared to boost your earnings!

Canadian Notes

A second natural-gas pipeline to export southwestern Alberta and British Columbia natural gas to the United States is being planned by Westcoast Transmission as part of a $100,000,000 expansion program announced by President Frank McMahon.

The new 30-in. line will stretch from large, newly discovered gas fields at Savanna Creek in the mountainous regions of southwestern Alberta close to the British Columbia border to the USA boundary at Kingsgate. Total distance of the new line will be 174 miles.

Gas in the field, owned by Phillips Petroleum, has been contracted to Westcoast. The contract calls for the delivery of 125 MMCF on a peak day. The line will provide service for Coleman, Blairmaore, and other areas in Alberta and Natal; Cranbrook, Fernie, Kimberley, and other southeastern BC towns.

Gas will be exported to the USA at Kingsgate through the facilities of Pacific Northwest Pipeline Corp. of Houston, Texas. The new Westcoast line and a 500-ton-per-day sulfur plant to be built in southwestern Alberta will cost a total of $45,000,000.

The new gas development is expected to spark renewed interest in the Flathead area of southeastern British Columbia, long considered a favorable spot for natural-gas and oil exploration. Because it is remote from the rest of the province and closer and more accessible to the USA, its development has been hindered.

Phillips has announced from Bartlesville, Okla., that its deal with Westcoast will "bring the highest prices of any Canadian gas sales we know of and will furnish an outlet for the gas discovered by Phillips and others at Savanna Creek."

A. E. Ames & Co.

Limited

Government, Municipal

and Corporation Securities

A. E. Ames & Co.

Members

Toronto Stock Exchange

Montreal Stock Exchange

Canadian Stock Exchange

United States Affiliate:

A. E. Ames & Co. Incorporated

New York • Boston

Business Established 1889

Toronto

MONTREAL LONDON, ENG. VANCOUVER VICTORIA
WINNIPEG CALGARY LONDON HAMILTON OTTAWA
KITCHENER ST. CATHARINES OWEN SOUND QUEBEC

The remaining $55,000,000 to be spent in the Westcoast expansion will go to increase the capacity of its 650-mile 30-in. Peace River to Vancouver line to 660 MMCF from 400 MMCF per day. The expansion program will raise Westcoast's expenditures to $270,000,000.

Increasing the capacity of the Westcoast main line means the building of additional compressor stations and other facilities to provide a greater flow for use in British Columbia and for export.

Westcoast has contracted to supply 350 MMCF per day to Pacific Northwest for export to the USA. The British Columbia Electric Railway and the Inland Natural Gas Co. have both exercised options under their existing contracts to take substantially larger amounts of gas for use in British Columbia.

Originally the BC Electric had contracted for delivery of 20 MMCF per day. Markets in the southwestern portions of the province have grown so much that the company has now increased this to 47 MMCF per day. Under the original line capacity the BC Electric has an option to seek a maximum of 130 MMCF per day.

New Catalytic Reformer for British American Oil

British American Oil has awarded a contract for a new catalytic reforming unit at its Edmonton refinery to the Lummus Co. of Canada Ltd. Capacity of unit will be 4,000 b/d of high-octane reformed gasoline as a blending component in B-A gasolines. Construction will get under way in the early summer, and the unit is scheduled for completion by the end of 1957.

B-A opened its Edmonton refinery in 1951. It has a crude capacity of 7,000 b/d.

Spends $80 Million On Pipeline Projects

Work on five pipelines in Saskatchewan, Canada, made this one of the most exciting parts of Canada in the way of oil during 1956.

Estimates are 18 million barrels of crude oil were produced in the province during the year, twice 1955 production. Some 70 drilling rigs were active.

Some $80 million was spent in the province, and 2,500 workers were on the job with the coming of snow.

The pipelines are:

(1) Trans-Canada Pipe Lines Ltd., a huge gas line.
(2) Westspur Pipe Line Co., building a $5 million line of 106 miles to link up Alida, Nottingham, and Midale areas to near Cromer, Manitoba.
(3) South Saskatchewan Pipe Line Co., building a $3 million line of 60 miles to southwest corner of the province.
(4) Trans-Prairie Pipe Lines Ltd., which hopes to complete soon a 17-mile line to Weyburn-Halbrite field, north of Estevan.
(5) Saskatchewan Pipe Line Corp., a $2.5 million line to Moose Jaw and Swift Current.

Some 700 miles of line pipe was shipped into the province, and only Trans-Canada reports shortages growing out of the steel strike in the USA.

Imperial Contract to Foster Wheeler

A contract to build a powerformer unit at Imperial Oil's Winnipeg refinery has been awarded to Foster Wheeler Ltd. Foster Wheeler will be doing engineering work during the winter months, and actual construction of the powerformer will get under way in the spring. The unit is expected to be completed in the early part of 1958.

Shell Appointments At Montreal and Toronto

J. L. Miller has been appointed manager of Shell's Montreal East refinery, succeeding L. T. Wilson, transferred to Venezuela. Mr. Miller has been with Shell for 36 years, and prior to his appointment was superintendent-operations, Houston refinery, Texas.

J. C. Fisher has been appointed assistant department manager, catalytic cracking department, at the Montreal refinery, succeeding S. J. Hutchinson, who becomes assistant department manager, topping and thermal cracking department. H. Mitchell, formerly at Montreal, has been appointed assistant manager at the Toronto blending and packaging plant.

Leduc Observes 10th Anniversary

The start of Canada's oil boom can be measured from the discovery of Leduc field, a monument to the persistence and optimism of Canadian oil explorers.

The field was discovered by Imperial Oil Co. after what must appear an incredibly difficult search. The company had drilled 133 dry holes before Leduc came in, in difficult country where almost all oil has to be found in a stratigraphic play —meaning that few if any surface indications of structure can be relied upon.

The discovery well, No. 1 Leduc, has been followed by 1,255 wells capable of production in Leduc at present, 10 years exactly after Leduc's discovery on February 13, 1947. The field has produced 142,797,680 barrels of oil over that ten years, an average of about 40,000 b/d. While Imperial brought the field in, there are over 80 operators participating now. The original discovery well has produced about 215,380 barrels of crude.

Arthur C. P. Jones

Jones Represents Business Development

Arthur C. P. Jones, attached to the assistant general manager's department of the Bank of Montreal in Vancouver for the past year, has been appointed a special representative of the bank's business development department, with headquarters at Calgary. He will work with C. A. P. Leahey, special representative, in the bank's development operations in the oil fields of Alberta.

Partially Clad Vacuum Column fabricated and erected by CB&I for PEMEX expansion

This 63-ft. high vacuum column is a part of Petroleo Mexicanos recent increase in overall refinery capacity. Partially clad with 405 stainless steel, it was fabricated at our Birmingham plant and furnished through the Fluor Corporation, Ltd. to the Minatitlan refinery along with several other process and storage vessels.

CB&I has complete facilities located throughout the world to create special and standard steel plate structures to the most exacting requirements of the petroleum industry. When you plan steel plate structures for your refinery, write our nearest CB&I office for help and information.

Above: 63-ft. high vacuum column partially clad with 405 stainless steel built by CB&I for Petroleo Mexicanos Minatitlan refinery.

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
New Orleans • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • South Pasadena • Tulsa
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.
REPRESENTATIVES AND LICENSEES:
Australia, England, France, Germany, Italy, Japan, Netherlands, Scotland
SUBSIDIARIES:
Horton Steel Works Limited, Toronto; Chicago Bridge & Iron Company Ltd., Caracas; Chicago Bridge Limited, London; Sociedade Chibridge de Construcoes Ltda., Rio de Janeiro.

Latin American Oil News

Hydrofining Unit at Amuay, Venezuela

Predictions of future markets currently supplied by Creole Petroleum Corp. indicate the need for reducing the sulfur content of products such as heating and diesel oil. In order to meet these demands, a hydrofining plant for reducing the sulfur content of middle distillates will be constructed at Creole's Amuay Bay refinery, northwestern Venezuela. The plant will be of the catalytic type, and will use gas rich in hydrogen to convert the small quantities of sulfur present in middle distillates to hydrogen sulfide, which can be easily removed from the oil.

With construction by Foster Wheeler to begin in April, plant should be completed by February 1958.

Opening of Manaus 5,000 B/D Refinery in Brazil

One of the world's most modern and complete oil refineries officially was placed in operation early in January, when Companhia de Petroleo de Amazonas (COPAM) opened its new 5,000 b/d refinery at Manaus, Brazil. Located 1,000 miles up the Amazon River, it was designed by Southwestern Engineering Co. of Los Angeles.

Designed for flexibility in handling a variety of feed stocks, the plant represents a major step in Brazil's determined effort to develop the upper Amazon region. The installation comprises a complete refinery, including a crude and vacuum unit, as well as a UOP fluid catalytic cracker. Included in the project are auxiliaries such as tanker loading and unloading facilities, tank farm, steam and electric generating plants.

Dedication ceremonies were attended by representatives of Brazilian government and industry, including President Kubitschek of the republic; Colonel Mario Poppe de Figueiredo, president of National Petroleum Council; and Colonel J. Nunes, president of Petrobras, the Brazilian government's petroleum administration. COPAM is a private enterprise operation, whose development was encouraged by the Brazilian government.

Gravity Survey in Bolivia

Seismograph Service Corp., Tulsa, has signed a contract with the Bolivian Gulf Oil Co. for gravity survey work in Bolivia. M. W. Tyrrell will head the crew. The award brings to 14 the number of SSC crews in South America.

DIAMOND CORE DRILLING | SPECIAL SUPERVISION

AIR OR MUD DRILLING | ELECTRIC LOGGING

REASOR DRILLING COMPANY
TEST HOLES WATER WELLS SHOT HOLES
DALLAS, TEXAS

Ralph E. Reasor
5612 Bryn Mawr
FLeetwood 2-1940
Dallas 9, Texas

Wilson Transferred to Venezuela

The manager of Shell's Montreal East refinery, L. T. Wilson, has accepted an appointment as director of refining and supplies with Compania "Shell" de Venezuela. He is to begin his duties in Caracas early this year.

First to Explore Offshore in Central America

Offshore oil drilling and exploration was to start off Nicaragua's Caribbean coast in February. The Waterford Oil Co., of Bismark, N. Dak., holder of concession rights to practically all of Nicaragua's Caribbean coast area, has contracted with the J. Ray McDermott Drilling Co., of New Orleans, to do the actual drilling. The drilling barge arrived at Nicaragua late in January, with a crew of 80.

Actual location of the drilling barge will be 23 miles off the coast of Nicaragua, east of Punta Gorda.

Waterford Oil Co. obtained the concessions in 1956, and conducted extensive seismograph operations in December. The concessions involve an area of approximately 4,000,000 hectares.

Oil sources state that this will be the first offshore test drilling so far conducted off the coast of Central America.

Offshore Work in Panama

Champlin Oil & Refining Co., of Fort Worth, Texas, plans shortly to conduct seismograph work on its Chiriqui lagoon concession in Bocas del Toro, Republic of Panama. Champlin obtained the concession from a Texas group to whom the rights originally had been granted by the Panamanian government.

Elsewhere in Panama, Caribbean Internation SA, which has been conducting exploration and test drilling on its Darien area concession, near Colombia, reports its operations at a standstill.

New Paraguay Pipeline

Agreement for the construction and operation of oil pipelines has been reached between Bolivia and Paraguay.

Under the agreement, Bolivia is to construct a pipeline into Paraguay to a port on the Paraguay River for export of her oil to world markets. Paraguay is to allow importation of the necessary personnel and equipment.

In addition, Bolivia is to construct a line to a point on the border with Paraguay, and Paraguay is to carry on the line in its territory. This line is to supply Paraguay with oil. The line is to be of 1,000 b/d minimum capacity, which may be stepped up to 5,000 b/d.

Brazil To Produce 30,000 B/D in 1957

Crude production in January 1957 in Brazil was estimated at 23,124 b/d. Of 320 producing wells, 127 were worked in December.

Crude production in 1956 totaled 80,425 b/d; in 1955, 40,438 b/d; and 1954, 19,848 b/d.

Petrobras predicted production would reach 30,000 b/d early in 1957. Production is limited by Mataripe's processing capacity and the amount of national crude other refineries can absorb.

Compared with 1955 production, natural gas in Bahia increased by 35% in 1956, to 83,877,536 cu m.

Bahia's oil reserves were officially confirmed at 315 million barrels in December.

Footage drilled in Bahia in 1956 totaled 229,721 including wildcats to 95,891 ft. Comparative figures for 1955 are 111,228 ft and 57,603 ft. Preparations have been made to drill 17 wildcats in Bahia this year.

Petrobras estimates the saving on imports in 1956 at US $52,685,000, viz., on crude (3,915,000 bbl),, $11-745,000; natural gas (450,000 bbl), $1,350,000; refined products from government plants and asphalt factory, $27,990,000; sea transport, $11,600,000. Private refineries effected an additional saving of $13,-705,000.

New Geophysical Company in Panama

Petrolex of Panama Corp. has been formed to do geophysical work for oil concession holders in Panama. Heading the organization is John W. Flude, well-known geophysicist of Houston, Texas. He is also vice president and general manager of International Geophysical Explorations Inc. Mr. Flude has developed methods for exploration of marine areas, and holds 13 US, Canadian, and Mexican patents in that field. He has been engaged in geophysical work since 1927. His most recent foreign efforts in this area, however, have been in the Republic of Honduras, where test drilling is currently being conducted.

First UOP "Cat" Cracker in South America

South America's first fluid catalytic cracker designed by Universal Oil Products Co. has gone onstream at the Companhia de Petroleo da Amazonia refinery at Manaus, Brazil.

The 2,000 B/SD unit produces a 95-octane F1 plus 3 ml TEL product from a synthetic blended crude stock, and reached guaranteed output within 2 days of startup. This unit is part of complete 5,000 B/SD refinery designed by Southwestern Engineering Co., Los Angeles, Calif., which also supervised construction of the plant.

All-Aluminum Pipeline Laid

The longest aluminum pipeline ever to be assembled will be used in the South American jungle to carry crude oil from an outlying producing field to a tank farm. The 6-in. light-metal line will link Colombian Petroleum Co.'s Tibu field to the firm's producing installation at Rio de Oro, a distance of 42 miles. Reynolds Metals Co. shipped the aluminum pipe in 40-ft sections from its Phoenix, Ariz., extrusion plant. The shipment represents the largest aluminum order ever placed for pipeline application. It is believed the line will provide compensatory advantages over steel pipe, and will be in operation a full year ahead of the time an installation of steel pipeline could be finished.

Research Finds Oil Reserves

An American oil research executive recently said that proved reserves of petroleum in the USA are steadily increasing. E. Duer Reeves, executive vice president of Esso Research and Engineering Co., said that in 1927 the USA had less than a 12-year supply of oil left. Today the same type of statistics show we have a 12½-year supply left.

"Actually, we have produced and sold many times the amount of oil indicated to be left to us when some dire predictions were made years ago, and continue to be made," he declared before a conference sponsored by the US Consulate in Hamburg, Germany.

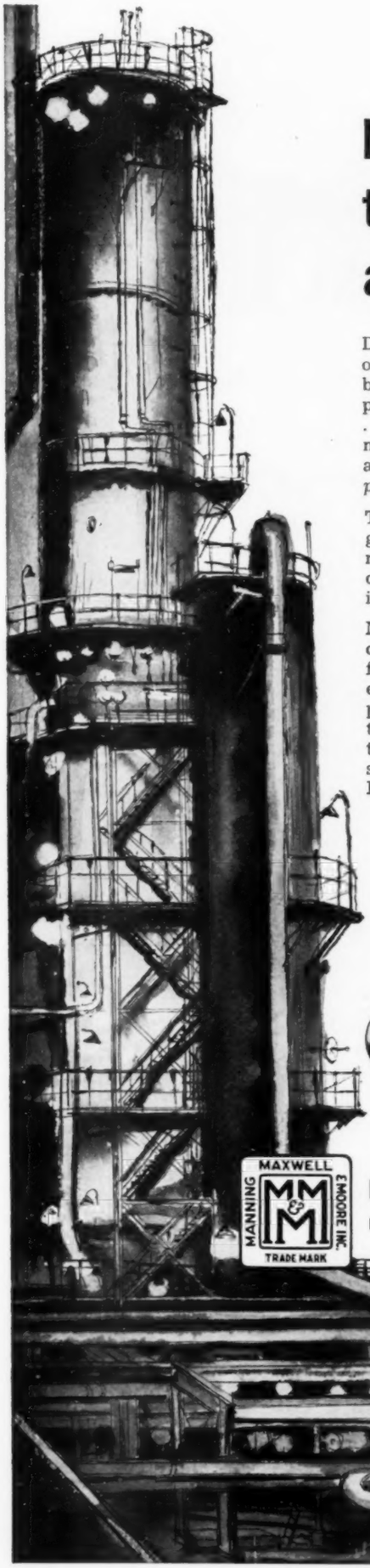
Some of the confusion about oil reserves, he explained, stems from the term "proved reserves." When the oil industry talks about its proved reserves, it is talking only about those reservoirs that have actually been measured and from which we are certain we can withdraw calculated amounts of oil.

"One of the reasons we have been able to increase our proved reserves," said Mr. Reeves, "is because the oil industry has done a great deal of research. It is more difficult each year to find oil, but also each year we have better methods of finding it."

He also pointed to the development by petroleum researchers of alternate sources of raw material for energy. "Throughout the world there are very large deposits of oil shale and tar sands that can be used in place of crude oil. The oil industry has developed processes which can make products from all of these equal in quality to those produced from crude oil."

The costs of operating these processes would be prohibitive at the present time, but in some instances "if the industry had to swing over from crude oil to some other raw materials, this could be started tomorrow."

Mr. Reeves, whose firm is the scientific affiliate of Standard Oil Co. (N.J.), described industrial research as the "most important raw material and the foundation for an ever-expanding economy in America." Today, in the United States, he estimated research and development expenditures by both industry and government are about $5 billion, in comparison with only $200 million spent in 1930.



Now available to the petroleum industry anywhere

Demand abroad by the petroleum industry for our industrial instruments and valves is now being met by manufacturers well-known for precision and quality production. These licensees . . . in England, France, Belgium, Western Germany, and Italy . . . help to assure global availability of these products and make it possible for *payment to be made in local currency.*

The year-after-year service record of our gauges, safety and safety relief valves, pneumatic transmitters and steel valves has won increasingly greater preference for these products in the United States, Canada and Latin America.

Now you can specify and readily obtain precisely the same reliability and high performance for your facilities anywhere in the world. The experience, skills and tools of our licensees are producing our brands to standards that satisfy the most exacting requirements. We recommend that you acquaint them with your projects and specific product needs, or write to our Export Division.

IN ENGLAND

Dewrance & Co. Ltd., London, S.E. 1
Ashcroft Duragauges
Ashcroft Pneumatic Transmitters
Consolidated Safety Relief Valves
Consolidated Safety Valves
Consolidated "Maxiflow" Safety Valves
Consolidated "Electromatic" Relief Valves
Hancock 800# Type 950 Steel Gate Valves

IN FRANCE

M.T.P. — SAPAG, Paris
Consolidated Safety Relief Valves
Hancock 1500# and 2500# Steel Valves
Hancock 800# Type 950 Steel Gate Valves
Hancock Steel "Flocontrol" Valves

IN BELGIUM

Ateliers Jaspar, S.A., Liege
Consolidated Safety and Safety Relief Valves

IN WESTERN GERMANY

Deutsche Babcock & Wilcox Dampfkessel-Werke, Oberhausen (Rheinl)
Consolidated Safety Relief Valves
Consolidated Safety Valves
Consolidated "Maxiflow" Safety Valves
Consolidated "Electromatic" Relief Valves

IN ITALY

Societa Carraro & Co., Milan
Consolidated Safety Relief Valves
Hancock Temperature Regulators
Filotecnica Salmoiraghi—SPA, Milan
Ashcroft Duragauges
Ashcroft Pneumatic Transmitters

IN CANADA

Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario
Ashcroft Gauges
Consolidated Safety and Safety Relief Valves
Hancock Bronze and Steel Valves

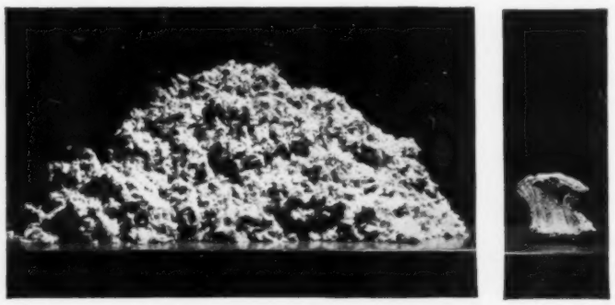
MAXWELL MANNING M&M MOORE INC. TRADE MARK

MANNING, MAXWELL & MOORE, INC.

Export Division • Chrysler Building East, New York, New York, U. S. A.

Refinery Insulation

All CAPOSITE moulded insulation materials are made of Amosite asbestos. The photograph clearly demonstrates the immense volume which is obtained when the natural Amosite is fiberised—the sign of high efficiency as an insulating medium.



CAPOSITE is supremely well suited to the thermal insulation of oil refineries. With a limiting temperature of 1000°F., high thermal efficiency and great structural strength and resilience, CAPOSITE has gained for itself a unique position among thermal insulation materials used by the Oil Industry.

CAPOSITE MOULDED ASBESTOS FIBRE PIPE INSULATION

EFFICIENCY DATA SHEET—PIPE SIZES 6" to 10" BORE.

HOT FACE TEMPERATURE °F.			400°F			600°F			800°F		
THERMAL CONDUCTIVITY K = B.Th.U. in./sq. ft./hr./in./°F.			0.43			0.47			0.53		
MEAN TEMPERATURE °F.			250			350			450		
Nominal Pipe Size	O.D. pipe	Thickness of Insulation	Heat Loss B.Th.U. sq. ft. hr.	Effic. %	Surface Temp. °F.	Heat Loss B.Th.U. sq. ft. hr.	Effic. %	Surface Temp. °F.	Heat Loss B.Th.U. sq. ft. hr.	Effic. %	Surface Temp. °F.
6"	6¼"	1"	135	87·7	126	233	90·6	167	354	92·5	218
		1½"	102	90·8	107	177	92·9	135	270	94·3	171
		2"	83·6	92·4	97	145	94·1	118	223	95·3	145
		2½"	71·8	93·5	91	125	95·0	107	192	96·0	128
		3"	63·5	94·2	86	110	95·5	100	170	96·4	117
		3½"	57·3	94·8	83	100	96·0	95	154	96·7	109
		4"	52·6	95·2	81	91·7	96·3	91	142	97·0	103
8"	8⅛"	1"	130	88·0	127	225	90·8	169	341	92·7	222
		1½"	97·7	91·0	108	169	93·1	137	258	94·5	174
		2"	79·2	92·7	98	138	94·4	120	211	95·5	148
		2½"	67·4	93·8	92	117	95·2	109	180	96·1	131
		3"	59·2	94·6	87	103	95·8	102	159	96·6	120
		3½"	53·2	95·1	84	92·7	96·2	96	143	96·9	111
		4"	48·5	95·6	82	84·6	96·5	92	131	97·2	105

These figures are compiled from results of official tests by THE NATIONAL PHYSICAL LABORATORY, TEDDINGTON, computed in accordance with formulae shown in BRITISH STANDARD SPECIFICATION appendices

CAPE

Please write for full technical details

THE CAPE ASBESTOS COMPANY LIMITED

114 & 116 Park Street, London, W.1.

Cables: Incorrupt, London.

CAPOSITE REGD

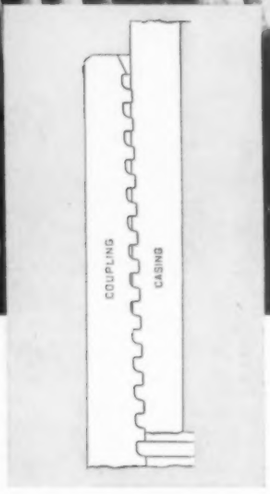
Enquiries in **CANADA** to: **Cape Asbestos (Canada) Ltd., 200 Bloor Street East, Toronto, Ont.**
U.S.A.: The North American Asbestos Corporation, Board of Trade Building, Chicago 4, Illinois

SOUTH AFRICA: Cape Asbestos South Africa (Pty.) Ltd., P.O. Box 2533, Johannesburg; ITALY: Capamianto S.P.A., via Sant' Antonino 57, Turin.
FRANCE: Isolamiante S.A., 37 Avenue Franklin D. Roosevelt, Paris 8e.

TA 10807

Why L-O-N-G strings call for

USS NATIONAL SEAMLESS CASING



With today's deep-well casing strings running longer and heavier than ever, better than ordinary casing is required to carry the weight safely. USS National Seamless Casing with buttress threads and couplings is specifically designed to bear the weight; and its walls possess the high collapse resistance needed to withstand the tremendous vibrations and pressures of deep-well drilling. Specify National Seamless Oil Country Tubular Products—casing, drill pipe and tubing—*wherever* strength is a big requirement.

Note these significant developments...

- **USS National Deoxidized Bessemer Steel Casing and Tubing**—Grades H-40, J-55. Especially well suited for oil production because of high yield strength, good ductility.
- **USS National Warm-Worked Casing Grade N-80**—Extremely high-strength casing. Uniformity of physical properties gives high collapse resistance and greatly increases joint strength. Hydrostatically tested to 80% of minimum yield strength up to a maximum of 10,000 psi.
- **USS National Deep-Well Casing**—A stronger casing to meet constantly increasing depths. Intended for severe service—hydrostatically tested to 80% of minimum yield strength up to a maximum of 12,000 psi.
- **USS National Buttress-Thread Casing**—Developed to meet the need for a casing joint which will safely and economically support the weight of deep-well casing. The buttress-thread joint is comparable in strength to the body of the pipe.

High tensile strength of the buttress-thread joint is due largely to completely engaged runout threads and 3° flank angle of threads which support weight of casing in well. Compares in strength to the body of the pipe! Eliminates the need for upset-end casing, gives greater clearance for bit, permits faster, easier coupling.

USS *Look for this trademark . . . your guide to quality steel*

UNITED STATES STEEL EXPORT COMPANY

30 CHURCH STREET, NEW YORK 8, U. S. A.

The top men at IX who supervise your seismic surveys have a total of 152 man years of experience . . . an average of almost 20 years per person.

Experience

is the priceless ingredient that goes into every IX survey

The personnel of Independent Exploration Company has packed more than 1,559 man years of experience into the company's quarter century of service to the oil industry. That's why Independent Exploration Company can offer you the tops in fast, accurate, informative geophysical surveys. Next time call in IX for a better job.

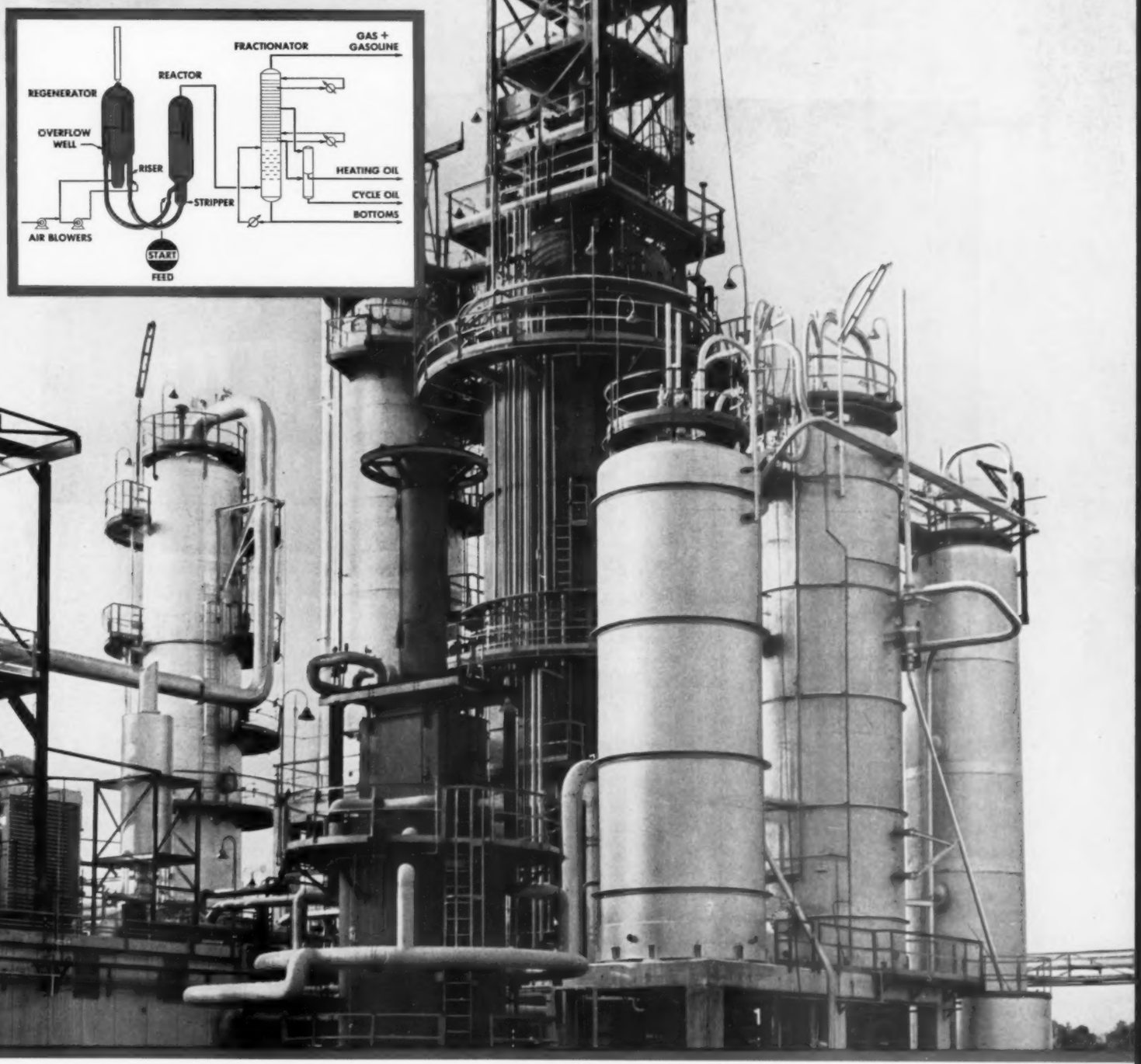
POINTING THE WAY IXC FOR THE DRILL

Independent Exploration Company

1973 West Gray, Houston, Texas
16 Coleman St., London E.C.2, England
1740 Broadway, Room B-232, Denver, Colorado

Geophysical Surveys

OVER 1,559 MAN YEARS OF EXPERIENCE



10,800 B/D LION OIL CO. DIVISION OF MONSANTO CHEMICAL CO. UNIT, EL DORADO, ARK.

MODEL IV CAN GIVE YOU FLUID CATALYTIC CRACKING AT LOWEST INVESTMENT COST

Esso Research and Engineering Company offers you *Model IV*, the simplest and most stable *Fluid Catalytic Cracking* process yet developed. The lower investment, maintenance and operating costs of the *Model IV Fluid Catalytic Cracker* are another achievement of the Esso Research program — 38 years of new process developments made available to refiners around the world.

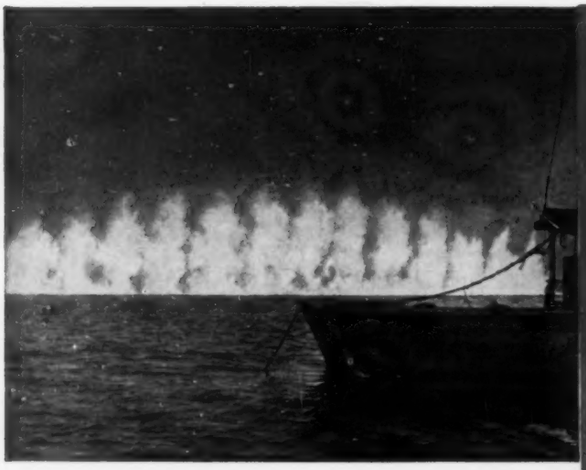
A new compact catalyst transfer system with smaller-sized vessels lowers over-all height and uses far less structural steel. Slide valves are eliminated—inherent self-stability and easy recovery from upset result in long run lengths.

First *Model IV* unit on stream was erected under license in 1952. Twenty-four *Model IV's* have since gone on stream—more than half of their capacity under license. Nine more units are in the construction or planning stage. Flexible *Model IV Fluid Catalytic Cracking* can play an important part in helping you meet changing market demands easily and economically. We would welcome your inquiry.

ESSO RESEARCH AND ENGINEERING COMPANY

15 West 51st Street, New York 19, N. Y.

Your key to progress... an Esso Research process



Expand Your Exploration Frontiers with Petty's VARI-PATTERN® Technique

Which record would you interpret with confidence? Records (A) & (B) were shot out of the same hole—with the same spread length and location. Record (B) clearly demonstrates the superiority of Petty's patented "Vari-Pattern" technique.

Ordinary pattern shooting is not new to geophysical exploration. But Petty's exclusive "Vari-Pattern" process is new, and is obtaining consistently better data in many previously recognized poor record areas.

Essentially, Petty's "Vari-Pattern" technique reduces the effect of unwanted surface traveling waves and reinforces desired reflections. This is accomplished by appropriate variation of the sensitivities of geophones, and sizes of charges used in multi-unit patterns.

Petty's "Vari-Pattern" method is now being used for more economical oil exploration in many diverse areas. Decide now to put such unique modern methods—and the experience of this oldest exploration company—to work for you.

Petty GEOPHYSICAL ENGINEERING CO.

SAN ANTONIO 8, TEXAS

District Offices: Houston, Tulsa, Casper, Billings, Lafayette

SEISMIC GRAVITY MAGNETIC SURVEYS

New Standard petrochemical has an exciting place in your future

Hundreds of thousands of man hours in research produced these crystals that will revolutionize many paints and plastics.

HOUSE PAINTS THAT LAST YEARS LONGER, superstrong lightweight luggage, improved fibre-glass fishing rods and boats . . . these are some of the things that will come from Isophthalic*, a new petrochemical from Standard laboratories. Even though its possibilities have only begun to be explored, we have invested in a multi-million dollar plant to manufacture Isophthalic.

We're convinced it will make as important a change in your life as detergents, wrinkle-resistant fabrics and other modern wonders whose basic materials were products of Standard research.

Progress in the West means...

plentiful raw materials for 3000 manufacturing firms by 1965

Standard's economists say: "New products from Isophthalic will help provide employment for the 600,000 new workers in manufacturing the West will have by 1965."

*Manufactured and distributed by Standard's wholly owned subsidiary, Oronite Chemical Company.

STANDARD OIL COMPANY OF CALIFORNIA

plans ahead to serve you better

What Do You Wish Today
That You Had Done Years Ago?

READ WHAT ONE OPERATOR TOLD PGAC...

"...and now that we have used PGAC logging and perforating services for the past seven months with such excellent results from three exceptionally difficult completions, we certainly wish that we had tried your services the first time we read one of your ads years ago."

The Record Proves...
Most Operators
PREFER
PGAC
Because They Always Get
BETTER
Logging And Perforating
RESULTS

A Year From Now...
What Will You Wish
That You Had Done Today?

PGAC-573

PERFORATING GUNS ATLAS CORPORATION

Houston, Texas Telephone REpublic 4-1651
General Offices and Main Plant: 7730 Scott Street — Sales Office: Melrose Building

PGAC OIL FIELD SERVICES

CALL FOR PROMPT SERVICE — ALWAYS READY TO SERVE YOU

TEXAS: Abilene — Alice — Beaumont — Bowie — Colorado City — Corpus Christi — Dallas — Fort Worth — Gainesville Graham — Houston — Longview — Midland — Odessa — Pampa — Victoria — Wichita Falls.
OKLAHOMA: Ardmore — Healdton — Oklahoma City — Pauls Valley — Pawhuska — Perry — Tulsa.
LOUISIANA: Houma — Lafayette — Lake Charles. KANSAS: Great Bend — Harper — Liberal. NEW MEXICO: Hobbs.

AFFILIATE COMPANIES: CANADA — Perforating Guns of Canada, Ltd.; Edmonton, Alberta
GERMANY — Atlas Deutsch- Amerikanische Olfelddienst G. m. b. H., Kiel VENEZUELA — Servicios Tecnicos Atlas, C.A., Caracas

DU PONT *Petroleum Chemicals* NEWS

One of a Series of Bulletins for the Petroleum Industry

MARCH 1957

Locomotive maintenance men report longer bearing life with fewer greasings

After switching to a grease based on Du Pont Estersil GT (grease thickener), one company substantially reduced bearing maintenance and replacement costs.

Running almost continuously, the company's 22 locomotives many times a day haul heavy cars from mine to surface. They operate in tandem to pull 210-ton loads seven miles up a 3% grade.

Bearing maintenance reduced

Under such rugged service, the temperature of the four armature bearings in each locomotive rises as high as 300°F. Before an estersil-based grease was used, the bearings were greased every month. Now with estersil grease, the job is done only every *two* months.

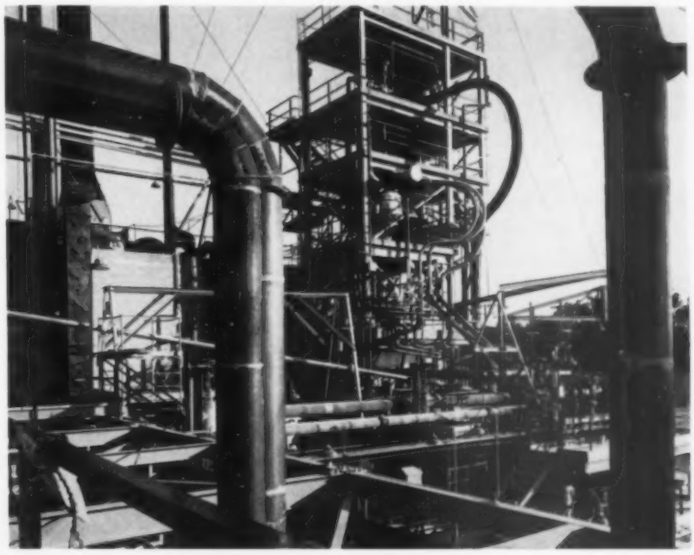
The company's mechanics report important savings on bearing replacement as well. They point to the company's previous average of one bearing replacement every two weeks. Since estersil-based grease has been used (six months), not a single bearing replacement has been necessary.

This compact locomotive operates under the toughest conditions. The grease packed into its armature bearings must have special properties to withstand the dust, high shear, and hot bearing temperatures.

The unique qualities of Du Pont Estersil GT are behind such dependable service. Estersil greases show outstanding resistance to mechanical breakdown and are practically immune to water, extreme heat and extreme cold.

New Du Pont West Coast TEL plant now in production

The new tetraethyl lead plant constructed by Du Pont at Antioch, California, is now on stream. This will make possible extra-fast deliveries of California-made TEL to all West Coast refiners.



Top of TEL pipe alley looking toward reactor tower.

The new plant is located approximately two miles east of Antioch on the San Joaquin River.

Integrated facilities

The new plant was built to meet the needs of the fast-growing West Coast oil industry. The present Du Pont Petroleum Chemicals Division regional laboratory at El Monte, and sales offices in Los Angeles, San Francisco and Seattle, together with the new plant, will provide complete service for TEL-users on the West Coast.

Plant most modern in the world

The new Du Pont plant has the most modern TEL manufacturing facilities in the world, incorporating in its design and equipment the latest continuous processing advances and many other production refinements.

A Du Pont Petroleum Chemicals Division representative will be glad to give you more detailed information about estersil GT and to provide samples. Contact any of our sales offices.

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DU PONT *Petroleum Chemicals* NEWS

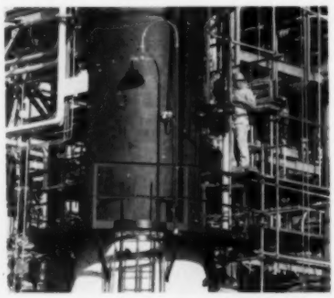
CONTINUED

New TEL Plant

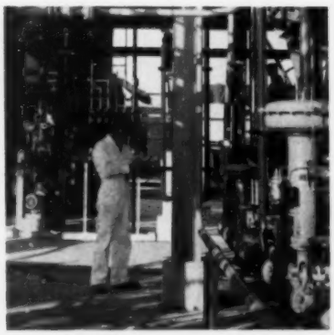
Another new Du Pont plant for making "Freon"* refrigerants and propellants is also located at Antioch. The "Freon" facilities were completed and production was started last fall.

Du Pont becomes a larger West Coast customer

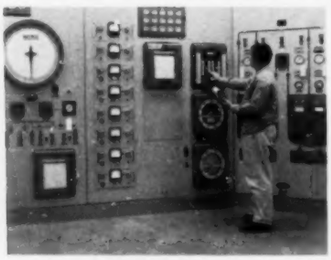
The two Du Pont plants at Antioch have become important new customers for large volumes of materials produced locally. Du Pont employees at Antioch already number 325; they were recruited locally.



Base of ethyl chloride column, TEL area.



Operator logging data in TEL area.



TEL central control room.

THESE MEN HEAD NEW ANTIOCH TEL PLANT

HENRY L. GREENE

DONALD C. MILLER

Top management posts at our new Antioch plant have been filled by Henry L. Greene and Donald C. Miller. Mr. Greene is plant manager and Mr. Miller assistant plant manager of the combined new TEL and "Freon"* refrigerant and propellant plants.

Mr. Greene joined the Du Pont Company in 1934 as a senior engineer. He advanced to supervisory posts at the Chambers Works, in New Jersey, then moved to Du Pont's neoprene plant at Louisville, where in 1946 he became assistant manager. In 1952 he was appointed assistant manager of the Savannah River Plant. He is a chemical engineer, a graduate of Kansas State College.

Mr. Miller came with Du Pont in 1937 as an analyst at Jackson Laboratory, Chambers Works. Following assignments in several other plants, he returned to the Chambers Works in 1943, where he became senior supervisor in TEL production. When in 1951 he was awarded the position of assistant works engineer, he was one of the youngest men ever to fill the job.

Mr. Miller received his B.S. in chemical engineering from Ohio State University.

*Registered Du Pont trademark.

LITERATURE AVAILABLE

Here is a partial listing of the many bulletins, reports, booklets, technical papers, and other aids available to you through any of the Du Pont Petroleum Chemicals Division offices:

Du Pont Estersil GT—A brief description of the properties, composition and applications of estersil grease thickener. Explains estersil grease preparation and contains handling information.

New Du Pont Dry-dye Eduction Probe and No-dust Drumhead—A folder describing and illustrating the revolutionary new dry-dye eduction devices, which make gasoline dyeing a cleaner, faster, and more efficient operation.

Sales Promotional Aids for Dealer Meetings—Describes the many Du Pont aids available for dealer meetings. A handy check list for anyone planning dealer meeting programs.

SALES OFFICES

Chicago 3—8 So. Michigan Ave. . . . RAndolph 6-8630
Cleveland 15—25 Prospect Ave. . . . SUperior 1-1363
Houston 2—705 Bank of Commerce Bldg. . . . . CApitol 5-1151
Los Angeles 17—612 So. Flower St. . MAdison 5-1691
New York 20—1270 Ave. of the Americas . . . . . COlumbus 5-2342
Philadelphia 2—3 Penn Center Plaza . . LOcust 8-3531
Pittsburgh 22—1 Gateway Center . . . ATlantic 1-2933
San Francisco 4—111 Sutter St. . . . . EXbrook 2-6230
Seattle 3—4003 Aurora Ave. . . . . MElrose 6977
Tulsa 1—1811 So. Baltimore Ave. . . . . LUther 5-5578
In Canada—Du Pont Company of Canada (1956) Limited, Petroleum Chemicals, 85 Eglinton Ave. East, **Toronto 12**—Ontario . . . . . HUdson 1-6461
In Other Countries—Petroleum Chemicals Division, Export Sales, 7496 Nemours Bldg., Wilmington 98, Del., OLympia 4-5121, Ext. 2962

DU PONT
REG. U.S. PAT. OFF.

Better Things for Better Living
. . . through Chemistry

OVER

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

A-3638

Printed in U. S. A.

World's Biggest Cat

NOW ON STREAM AT TIDEWATER OIL COMPANY'S DELAWARE

FLYING A REFINERY

Standing almost 25 stories high, with a throughput capacity of 102,000 barrels per day, this Orthoflow* Fluid Catalytic Cracking Unit is the largest and most productive cat cracker in the world. Basic in the manufacture of high octane gasoline and other petroleum products at Tidewater Oil Company's new, ultra-modern Delaware Flying A Refinery south of Wilmington, this huge process unit was designed and engineered by The M. W. Kellogg Company.

Tidewater's Orthoflow is the culmination of Kellogg's experience in engineering 16 smaller Orthoflow units and 50 fluid cat crackers of other types throughout the globe. These and the Tidewater unit represent a total throughput capacity of 1,482,722 barrels per day. Recent Orthoflow installations are helping to boost gasoline production in South America, Canada, Australia, and Western Europe, as well as in other U. S. refineries. In most cases, Kellogg's responsibility has entailed construction as well as design and engineering.

The M. W. Kellogg organization's world-wide facilities are helping in many ways to solve industry's engineering problems as these are related to the six areas indicated below. We welcome the opportunity to discuss the application of this broad experience to your specific needs.

*Trademark of The M. W. Kellogg Company.

REFINERY PROCESS DIVISION

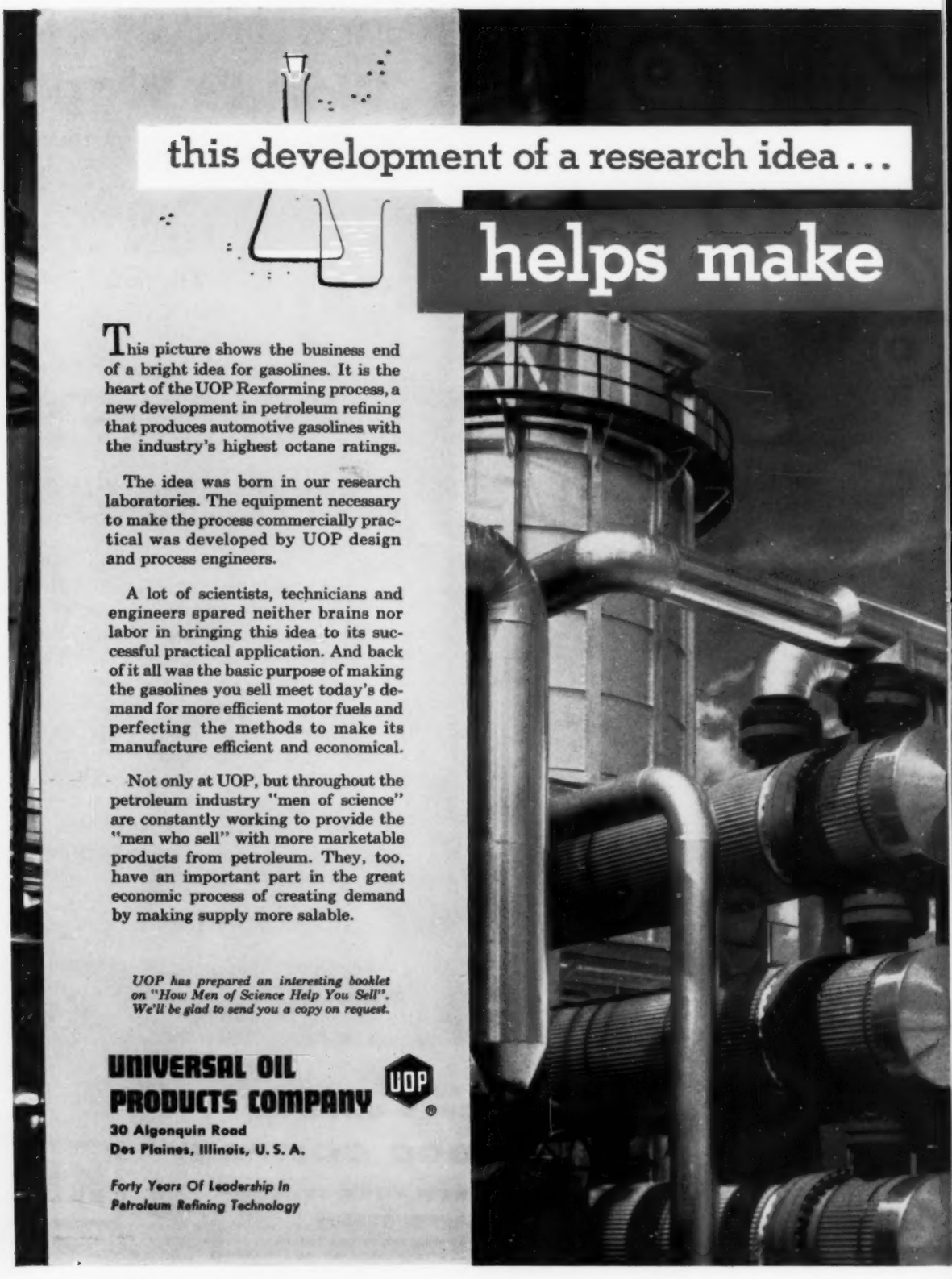
THE M. W. KELLOGG COMPANY

711 THIRD AVENUE, NEW YORK 17, N. Y.

A SUBSIDIARY OF PULLMAN INCORPORATED

The Canadian Kellogg Company Limited, Toronto • Kellogg International Corporation, London
Companhia Kellogg Brasileira, Rio de Janeiro • Compania Kellogg de Venezuela, Caracas
Kellogg Pan American Corporation, New York • Societe Kellogg, Paris

M KELLOGG W



this development of a research idea . . .

helps make

This picture shows the business end of a bright idea for gasolines. It is the heart of the UOP Rexforming process, a new development in petroleum refining that produces automotive gasolines with the industry's highest octane ratings.

The idea was born in our research laboratories. The equipment necessary to make the process commercially practical was developed by UOP design and process engineers.

A lot of scientists, technicians and engineers spared neither brains nor labor in bringing this idea to its successful practical application. And back of it all was the basic purpose of making the gasolines you sell meet today's demand for more efficient motor fuels and perfecting the methods to make its manufacture efficient and economical.

Not only at UOP, but throughout the petroleum industry "men of science" are constantly working to provide the "men who sell" with more marketable products from petroleum. They, too, have an important part in the great economic process of creating demand by making supply more salable.

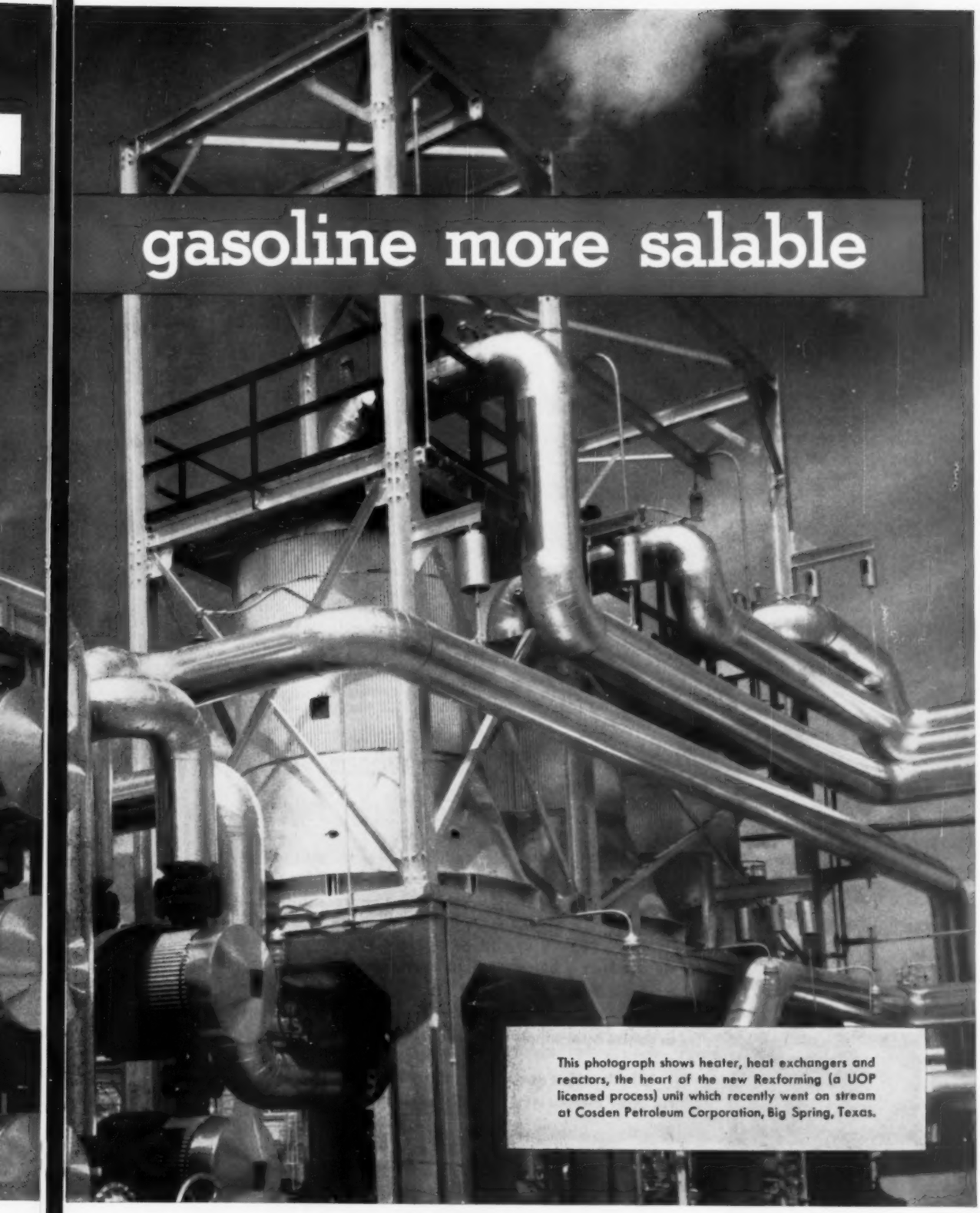
UOP has prepared an interesting booklet on "How Men of Science Help You Sell". We'll be glad to send you a copy on request.

UNIVERSAL OIL PRODUCTS COMPANY

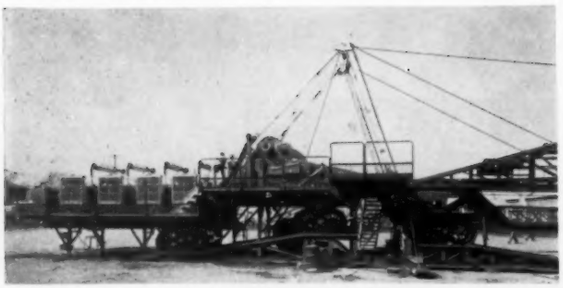
UOP

30 Algonquin Road
Des Plaines, Illinois, U. S. A.

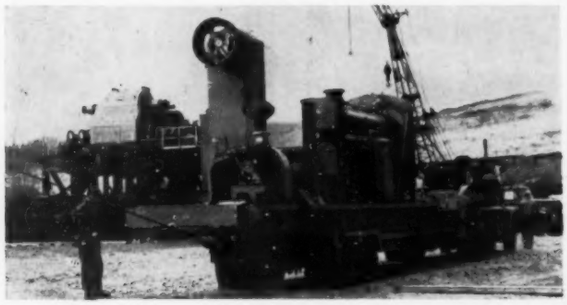
Forty Years Of Leadership In Petroleum Refining Technology



This photograph shows heater, heat exchangers and reactors, the heart of the new Rexforming (a UOP licensed process) unit which recently went on stream at Cosden Petroleum Corporation, Big Spring, Texas.

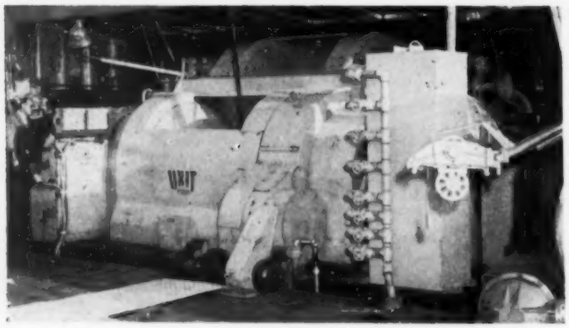


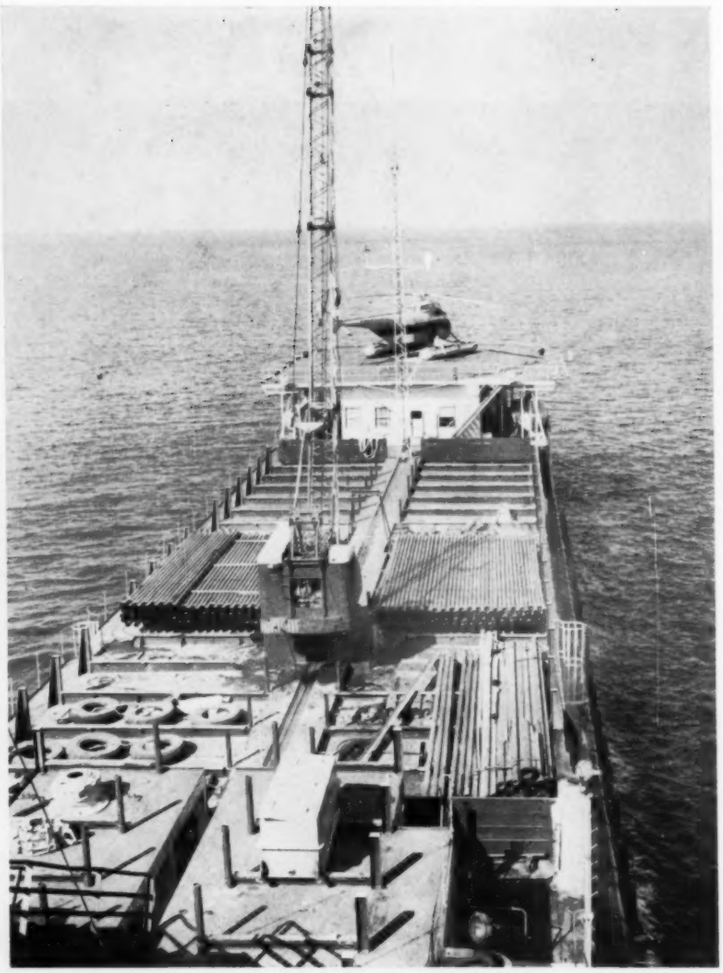
PERU—Designed for Mid-Continent customer in Peru, this drawworks and Unit Rig 4-engine rig drive is Athey track-mounted for easy moving over difficult terrain.



CANADA—Unit Rig U-1220 drawworks and Mid-Continent 3AE swinging compound rigging up at Canadian location. Below—wintertime at Drayton Valley, Canada.

VENEZUELA—Barge above equipped by Mid-Continent for use on Lake Maracaibo. Below—U-1220 Unit Rig drawworks electric motor powered for Gulf off-shore location.





GULF COAST—Drilling tender serving Mid-Continent—equipped barge off Louisiana Coast. Equipment includes Unit Rig U-1220 drawworks, 3AE Rig Drive, Emsco D-700 pumps, and pump drive.

Mid-Continent goes where you go with dependable oil field supplies

Men in the business of drilling and producing oil wells over the world, daily solve supply problems by keeping in close contact with Mid-Continent representatives.

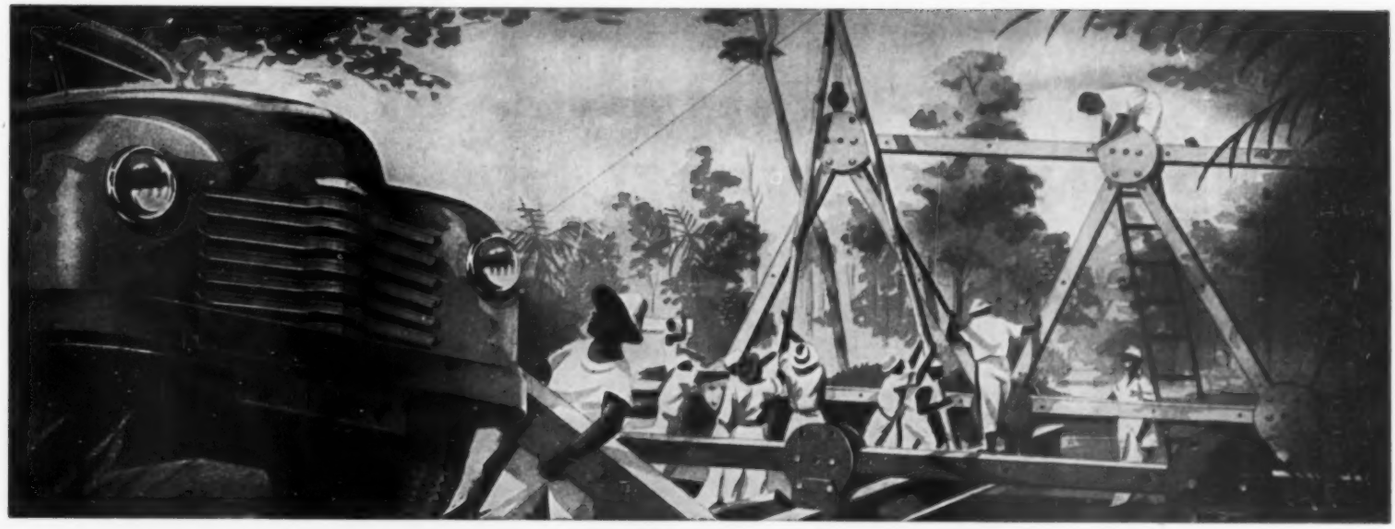
Mid-Continent Supply Company's completely-stocked field stores provide 24-hour service and famous brand products from Anaco and Maracaibo to the Canadian North Land . . . and Mid-Continent's Export Division is organized to supply oil producing regions world wide.

Whether you need a single item or a complete drilling rig, call Mid-Continent for sure service, sure supply.

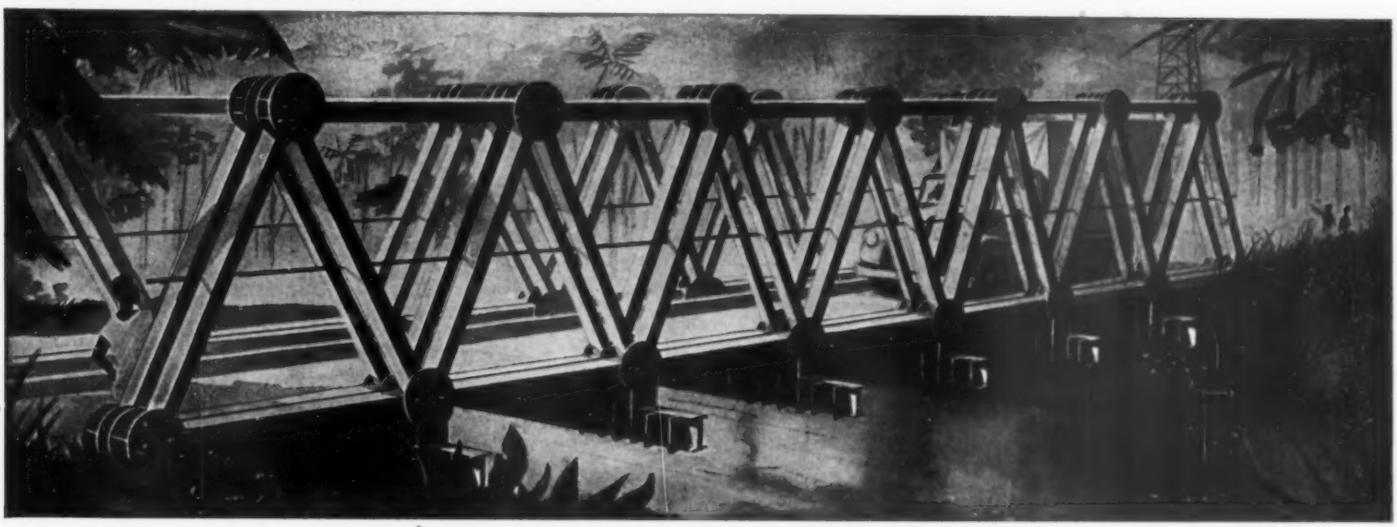
MID-CONTINENT
Supply Company
MID-CONTINENT BLDG. • FORT WORTH, TEXAS

THE WORLD'S LARGEST INDEPENDENT OIL FIELD SUPPLY COMPANY

Easily transported to . . .

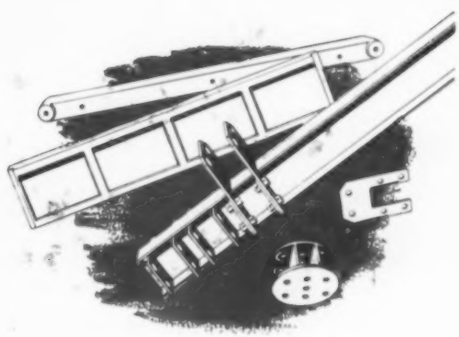


and quickly erected on . . .



remote up-country sites

Butterley Standard-Unit Bridges are in use all over the world where transport is difficult, skilled labour scarce or where site preparation has to be carried out under adverse conditions. From five standard units, all sizes of bridges can be built; the units can be sent by any form of transport; site erection is remarkably simple and swift with an absolute minimum of equipment.



THE BUTTERLEY STANDARD-UNIT BRIDGE

THE BUTTERLEY COMPANY LIMITED RIPLEY DERBY ENGLAND

London Office: 9 UPPER BELGRAVE STREET S.W.1.

Scammell

FOUR AND SIX WHEEL DRIVE TRUCKS

Illustration above shows one of the many 6 x 6 Scammell "Constructor" Oilfields Bed Tractors operating in Kuwait and other major oilfields of the world.

Built to 'take it' *on or off the highway*

Scammell 4 x 4 "Mountaineer" Oilfield Tractor.

Scammell four and six wheel drive trucks have been specially designed for operation under the most gruelling conditions. In tropical heat, in the Arctic snowy wastes, in soft, sandy or mountainous terrain—in fact wherever the going is rough and tough Scammell trucks provide the complete, economical and reliable answer for every type of oilfield transportation.

Scammell four and six wheel drive oilfield type trucks and tractors have chassis designed for mounting Well-servicing Hoists, Cranes, Excavators, Drill Rigs, Cement Transit Mixers, etc., etc.

Further details gladly sent on request.

SCAMMELL LORRIES LTD., WATFORD, HERTS., ENGLAND ***Telephone: Watford 5231; Telegrams: Twelfton, Watford***

"Het" and "Marge" better hurry up with their packing because with Rogers crews surveying the area they soon will be coming to the surface in cores. Rogers crews are experienced in working throughout the world and their world-wide knowledge enables them to locate "hard to find" prospective oil producing formations which may be overlooked by less experienced crews. So, wherever you plan to explore look to Rogers for accurate results.

Rogers Geophysical Company

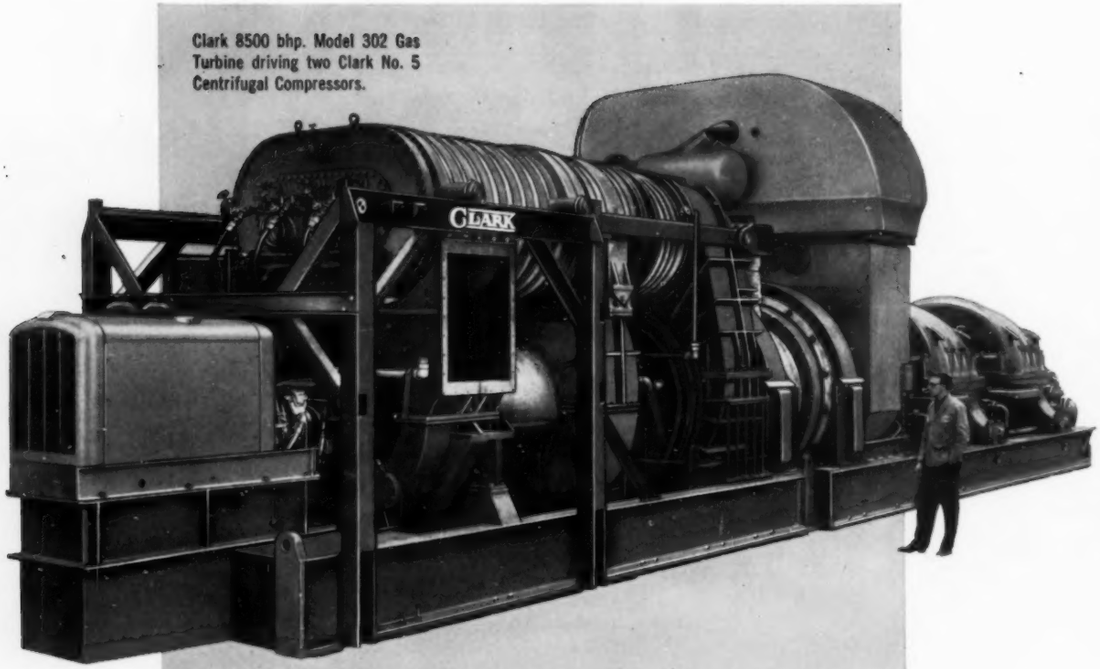
3616 WEST ALABAMA • HOUSTON, TEXAS

Edificio Republica
Caracas, Venezuela

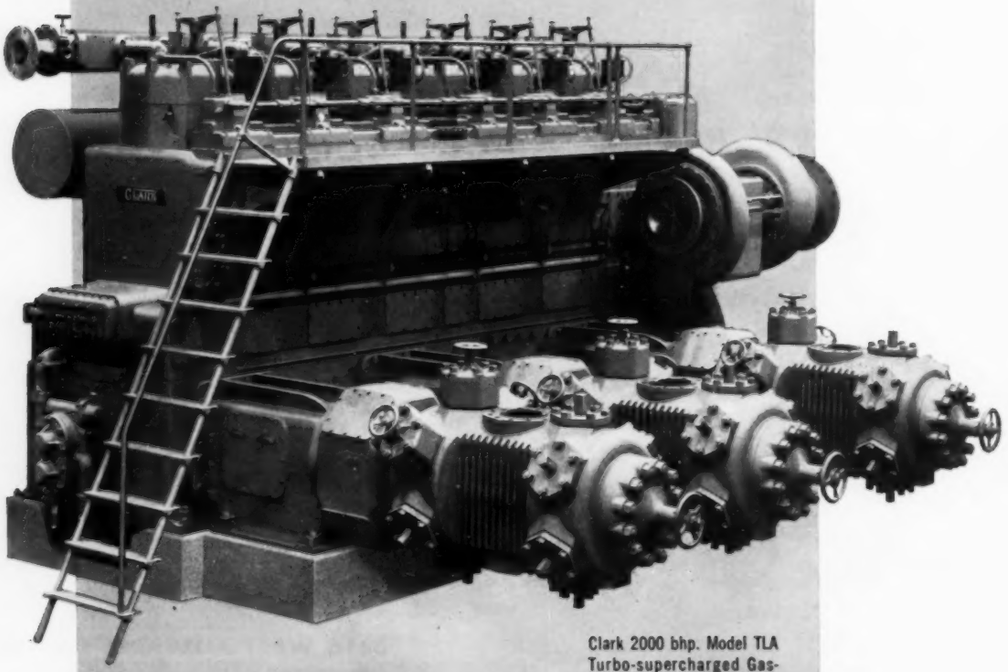
Mogadiscio
Italian Somaliland

34 Ave. des Champs Elysees
Paris, France

R O G E R S C R E W S G O E V E R Y W H E R E



Clark 8500 bhp. Model 302 Gas Turbine driving two Clark No. 5 Centrifugal Compressors.



Clark 2000 bhp. Model TLA Turbo-supercharged Gas-Engine-Driven Compressor.

Gas turbines or engines?

With Clark you eliminate

Prejudice

Gas turbine-driven centrifugal compressors or reciprocating compressors . . . you can get both types from Clark

Prejudice can add substantially to the cost when selecting compressors. At Clark, we build both gas turbine-driven centrifugal compressors and gas-engine-driven reciprocating compressors. In both instances the compressors and drivers are the most modern available.

Our chief concern is to be certain that you obtain the proper unit for your specific installation. This is where our experienced application engineers enter the picture. Both types of units have certain characteristics that may make one or the other best for your particular use. An unbiased opinion, after a careful examination of all the facts and conditions, is vitally important. Clark is the only company that can give you an unbiased opinion because Clark is the only company that builds reciprocating and centrifugal compressors in addition to gas turbines.

Clark application engineers will be pleased to help you determine the right type of compressor and driver combination for your next application.

CLARK BROS. CO., OLEAN, NEW YORK
One of the Dresser Industries
Offices in Principal Cities Throughout the World

CLARK®

Centrifugal Compressors
Reciprocating Compressors
Gas Turbines

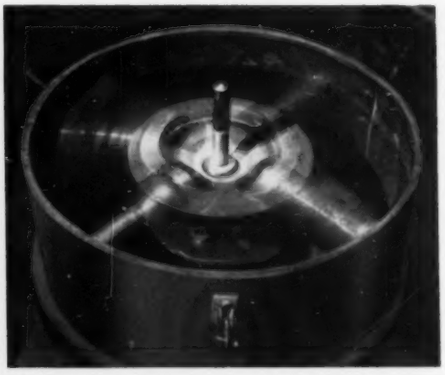
BY APPOINTMENT TO HER MAJESTY THE QUEEN
Suppliers of Fire Extinguishers — The Pyrene Company Limited

Putting out oil fires before they happen

Results more than justify the reliance which the oil industry places on 'Pyrene' foam for ensuring the fire safety of refineries, tank farms and dock installations throughout the world. To warrant this confidence . . . to make certain beyond all doubt that 'Pyrene' Foam Compound will at all times and in all circumstances provide the means of extinguishing fire quickly and conclusively, is the constant task of a team of chemical engineers in the Pyrene laboratories. Through their vigilance the most scrupulous production control is maintained over every gallon of 'Pyrene' Foam Compound that is manufactured, ensuring its unfailing efficiency and dependability wherever and whenever it may be called into action.

Seen distorted through the water bath which maintains the critical temperature of his apparatus, a physicist checks the viscosity of a sample batch of 'Pyrene' Foam Compound. The test determines that when brought into action 'Pyrene' foam will retain its free-flowing yet tenacious characteristics at all normal operating temperatures, down to 20° Fahrenheit.

Within the spinning container of the torsional viscometer a one-minute-old sample of foam, made from 'Pyrene' Foam Compound, deflects a van suspended by a steel wire. The degree of twist in the wire is the measure of the foam's viscosity—of its critical and continuous shear stress values—indicating its ability to 'cling' as well as spread easily.



Under the tremendous force of the laboratory centrifuge the slightest trace of sediment in this sample batch of 'Pyrene' Foam Compound is settled out, carefully collected, measured and recorded. . . . Under no circumstances will the batch be approved unless this test shows it to be sludge-free, in accordance with the exacting Pyrene production specification.

"Pyrene" Foam Generators and Foam-making Branchpipes • Fixed Foam Installations • Foam Towers • Foam Monitors • Foam Tenders and Trailers are designed to meet *all* oil fire risks. Write for details on the latest developments to W.P. 3.

Pyrene TRADE MARK **foam compound**

THE PYRENE COMPANY LIMITED

9 GROSVENOR GARDENS • LONDON S.W. 1 • ENGLAND • *Cables:* PYRENE LONDON

Head Office & Works: GREAT WEST ROAD • BRENTFORD • MIDDLESEX • ENGLAND

CANADIAN PLANT: PYRENE MANUFACTURING COMPANY OF CANADA LIMITED 91 EAST DON ROADWAY TORONTO 8

W-S Forged Steel Fittings

Now protected with...

new blue rustproof coating

That attractive color you see on our forged carbon steel fittings is a new synthetic coating that effectively protects the fittings against corrosion in stock and in service. The coating completely covers the fittings—inside and outside, thus protecting threads and sockets, as well as external surfaces.

If you are going to paint your piping system for color coding or other reasons, the new coating serves as an excellent base for paint. No objectionable rust or scale to scour off before painting.

All W-S forged carbon steel fittings, in both screw-end and socket-welding types, are now available with the new blue rustproof coating.

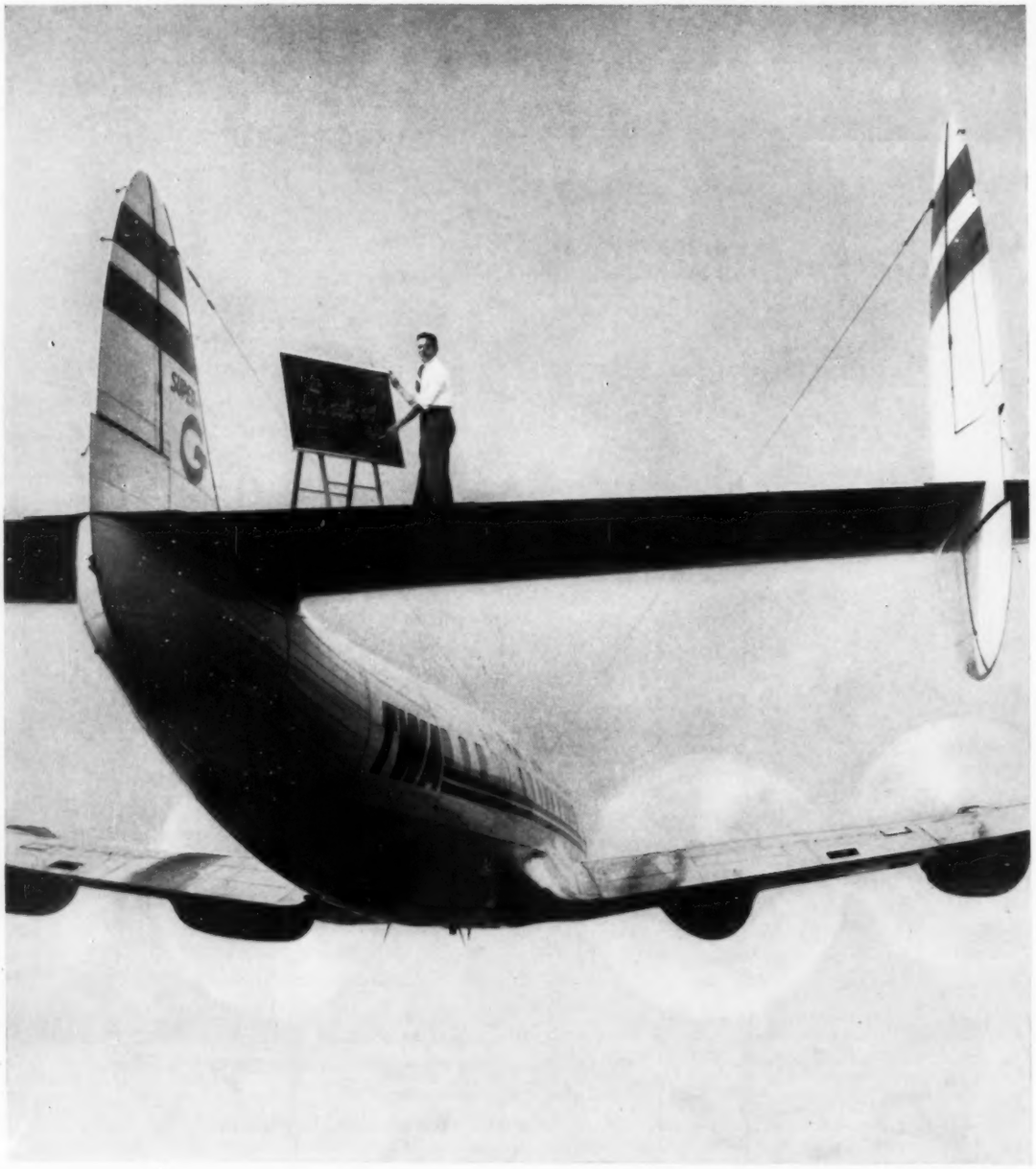
Remember the blue color. It labels the fitting a W-S Quality Product.

Send for your copy of Forged Steel Fittings Catalog A-3-56

HKP **W-S FITTINGS DIVISION**

H. K. PORTER COMPANY, INC.

Divisions: ALLOY METAL WIRE, Prospect Park, Pa. • CONNORS STEEL, Birmingham • DELTA-STAR ELECTRIC, Chicago
Henry DISSTON, Philadelphia • ESECO, Joliet, Ill. • LACLEDE-CHRISTY, St. Louis • LESCHEN WIRE ROPE, St. Louis • McLAIN FIRE BRICK, Pittsburgh
QUAKER PIONEER RUBBER, San Francisco • QUAKER RUBBER, Philadelphia • RIVERSIDE METAL, Riverside, N. J. •
VULCAN CRUCIBLE STEEL, Aliquippa, Pa. • W-S FITTINGS, Roselle, N. J.



Oilmen should be up in the air! An oil company physicist and his slate of equations may seem out of place in the sky. But airmen couldn't get off the ground without oilmen. Oil helped fly 50 million passengers on U. S. air lines last year. And oil company researchers are developing jet and rocket fuels that will shrink tomorrow's world even more. Remember these things when you hear misinformed people speak against your industry. Speak up—tell how you help give America wings! **SHELL OIL COMPANY** SHELL

How to speed up your automatic forging operations ...at no extra cost

TO get the continuous, fast operation vital to making the most of your automatic forging production lines, you need uniformity in the steel you use. High speed heat-treating and hardening operations are often interrupted by changes in chemical composition and structure of steel used. Uniformity cuts interruptions for adjustments. It helps you gain the full advantages of automatic operation. And you get the utmost in uniformity—at no extra cost—by using Timken® electric furnace fine alloy steel. It's uniform from bar to bar, heat to heat, order to order.

We take many extra quality-control steps to insure this uniformity. Some of them were "firsts" in the steel industry. For example, a magnetic stirrer for molten steel assures equal distribution of alloys, uniform temperature and working of the slag. And the Timken Company was also first to use a direct-reading spectrometer to insure uniform grain size and chemical composition right to the instant the heat is tapped.

To further assure uniformity, your order of Timken fine alloy steel is handled individually. We target our conditioning procedures to meet your end use requirements. Each bar is stamped to identify the heat it came from. This limits variations within an order as well as from order to order.

So to step up your automatic forging operations—at no extra cost—always specify Timken fine alloy steel. You'll get uniform results, faster, continuous production, time after time. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

TIMKEN *Fine Alloy* STEEL

TRADE-MARK REG. U.S. PAT. OFF.

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

The NEW SAFFIRE COMBINED OUTFIT

FOR WELDING, CUTTING, HEATING, FLAME CLEANING

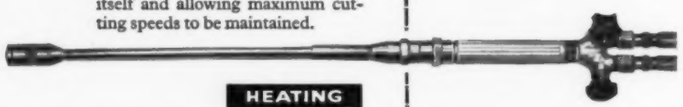
Here for the first time is an outfit that can be used for all these operations. The basis is a common shank to which the various heads for welding, cutting, heating and flame cleaning can be fitted, easily and quickly. With one shank you can build up the set with some or all the heads to meet your needs as they occur. Alternatively you can buy the complete outfit with the entire range of heads in a portable case.

WELDING

A complete range of swaged or detachable tips are available covering all welding requirements up to 1".

CUTTING

The cutting attachment will cut steel up to 2" thick. The highest degree of safety is ensured by the use of *nozzle-mixing*, limiting any possibility of backfire to the nozzle itself and allowing maximum cutting speeds to be maintained.



HEATING

The nozzles screw on to the straight welding neck or on to flexible necks which can be bent to any angle.

FLAME CLEANING

Flame cleaning attachments screw directly into the mixer and consist of a bent neck or a straight neck with a range of detachable flat or round nozzles.

For full details please write to:

BRITISH OXYGEN

BRITISH OXYGEN GASES LTD., BRIDGEWATER HOUSE, ST. JAMES'S, LONDON, S.W.1

GEOPAC

A concept in seismic interpretation

That brings SPEED, ACCURACY Through AUTOMATION

Geopac is a highly accurate and rugged unit, easy to operate, which automatically produces seismic cross sections at low unit cost—

Many computational operations necessary for reducing large amounts of seismic data to a form that allows geologic interpretation are routine in nature. That is why the General Geophysical Company designed and developed this automatic machine that facilitates computation—

Geopac offers 5 distinct advantages:

1. Improvement in speed
2. Reduction of human error
3. Reduction of unit cost
4. Ability to handle large volumes
5. Results presented in simple, organized cross section

A. Computer and Control Section
B. Magnetic Play Back Drum and Amplifier
C. Plotter Console

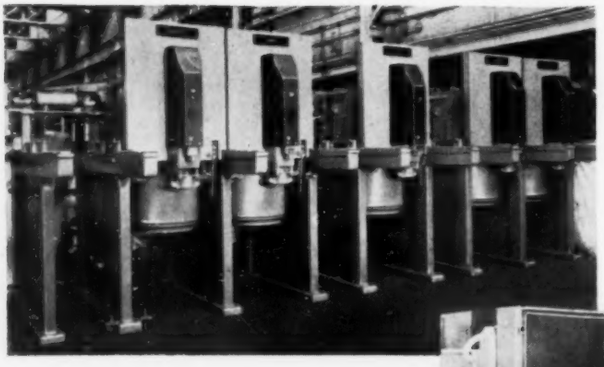
General Geophysical Company
HOUSTON CLUB BUILDING • HOUSTON, TEXAS

METALCLAD SWITCHGEAR

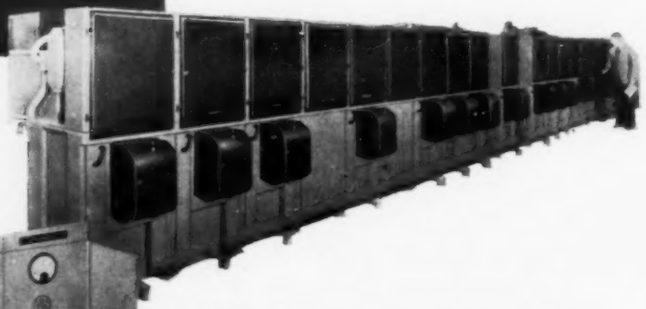
and remote control panels

for Oil Refineries

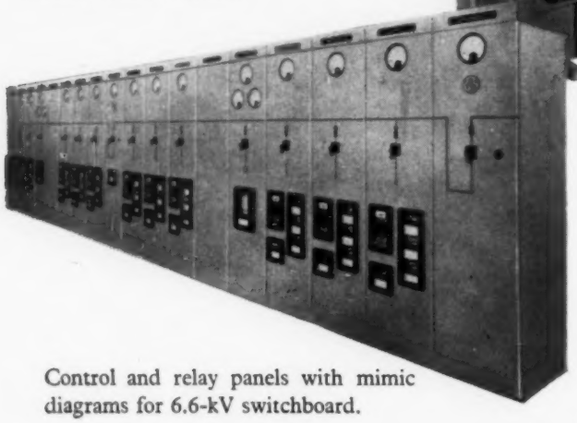
The Burmah-Shell Refineries Ltd. specified BTH 22-kV and 6.6-kV metalclad switchgear for their new Bombay Refinery.



Five-panel, 22-kV, 500-MVA solenoid-operated switchboard for the control of the incoming feeders (from the Tata Power Co., Ltd.) and 7,500-kVA transformers which supply electric power to the whole refinery.



Twenty-panel, 6.6-kV, 250-MVA solenoid-operated switchboard controlling the 7,500-kVA transformers and main refinery feeders.



Control and relay panels with mimic diagrams for 6.6-kV switchboard.

Manufacture is now proceeding with a further two 22-kV, and nine 6.6-kV, units for a third 7,500-kVA transformer and additional refinery feeders; BTH have also supplied a total of eighty-three 6.6-kV, 150-MVA hand-operated metal-clad switchgear equipments for the refinery substations.

BRITISH THOMSON-HOUSTON

THE BRITISH THOMSON-HOUSTON COMPANY LIMITED · RUGBY · ENGLAND

Member of the AEI group of companies

A4892

COLD ROLLED

HERE'S GOOD NEWS

for operators who prefer replaceable tool joints!

SEAL GRIP®

A DEVELOPMENT OF

HUGHES TOOL COMPANY

HOUSTON, TEXAS

You can now get the improved HUGHES "Seal-Grip" drill stem assembly that has been especially designed to withstand the increased stresses of deeper drilling. The new assembly is the result of the development and perfection by Hughes of new equipment and techniques for cold-rolling the large land area of drill pipe for "Seal-Grip" tool joints.

The value of cold-rolling has been strikingly demonstrated in a long series of laboratory and field tests. For instance, in laboratory fatigue tests—where pipe is run to destruction—*we have not been able to induce a single failure* in the cold-rolled area of the pipe.

HUGHES "Seal-Grip"—always dependable—now offers the operator the strongest, most versatile and efficient replaceable tool joint assembly he can buy.

Developers of "Flash-Weld," "Seal-Grip" and Counter Bore Weld Tool Joints

YOUR GUARANTEE OF PERFORMANCE

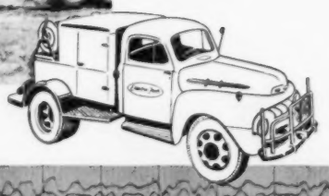
In the oil fields of the world the HUGHES trademark has been accepted as a guarantee of performance . . . *consistent, dependable performance* — for almost a half century. Through intensive and aggressive research, in the laboratory and in the field, HUGHES is continuing to advance the quality and performance of its products . . . worldwide.

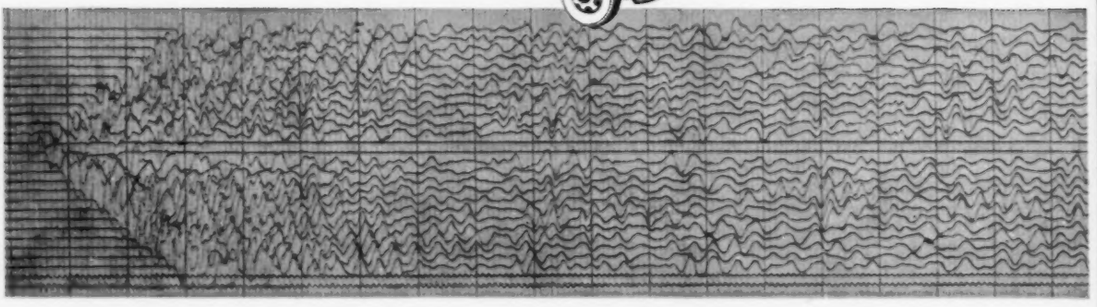
D
No matter
how you figure . . .
Davison's catalysts
give you more!
• Davison gives you quality
• Davison gives you service
• Davison's high stability catalysts save you dollars.
That's why Refinery Men know that when they buy
Davison they buy dependability in service and product.
DAVISON CHEMICAL COMPANY
Division of W. R. Grace & Co.
Baltimore 3, Maryland
Sales Offices: Chicago, Ill.; Houston, Texas; New York, N. Y.;
Baltimore, Md.; San Francisco, Calif.
In Canada: Davison Chemical Company Ltd., Toronto
Producers of: Catalysts, Inorganic Acids, Superphosphates, Triple
Superphosphates, Phosphate Rock, Silica Gels and Silicofluorides.
Sole Producers of DAVCO® Granulated Fertilizers.

Electro-Tech

First

. . . in the field . . . in modern geophysical instruments . . . as field proven by 90 per cent of the seismic crews operating in the world.





Magnetic Recording Systems

Pressure Detectors

Velocity Detectors

Blasters

...for the highest degree
of accuracy and reliability in:

...DETECTING

...AMPLIFYING

...MAGNETIC RECORDING

...DISPLAYING OF SEISMIC DATA

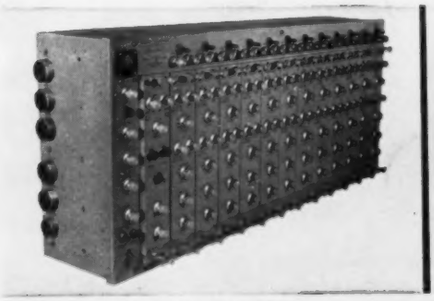
...insist **FIRST** on **ELECTRO-TECH**
instruments...always a step ahead
in design, manufacture, and service.

Electro-Technical Labs.

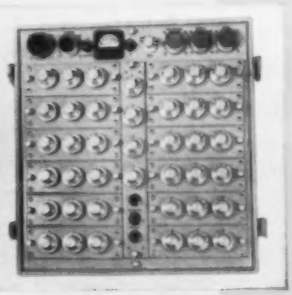
DIVISION OF MANDREL INDUSTRIES, INC.

5134 GLENMONT HOUSTON TEXAS. TEL. MO 7-6561

CABLE ADDRESS: EL TEC



Playback Amplifiers



Reflection-Refraction Amplifiers

Recording Oscillographs

ISE...

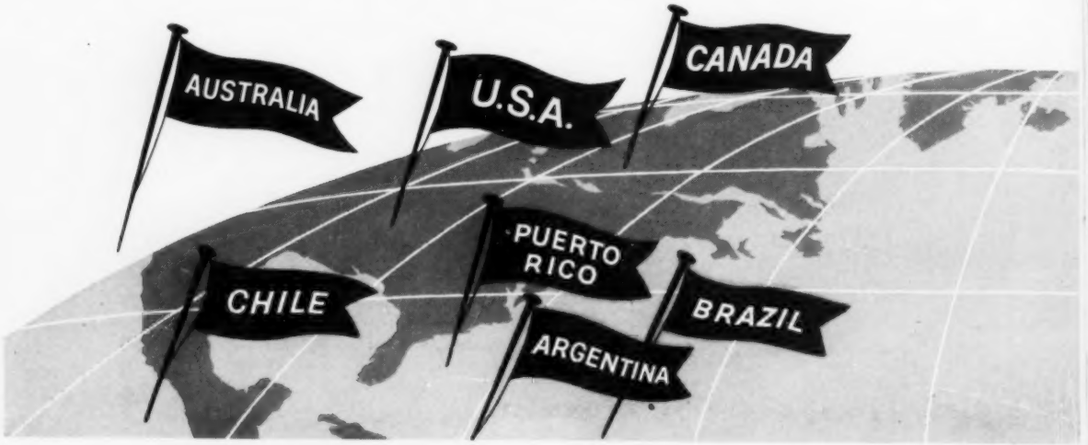
for electronics and

70 Factories in 20 Countries to Supply You—No matter what your electronic and telecommunication needs, you will find every desired service or equipment provided by International Standard Electric Corporation, an associate of International Telephone and Telegraph Corporation. ISE is one of the world's largest organizations in the development, manufacture, sale and installation of electronic and telecommunication equipment, and in the extension of licenses, patents, and technical assistance on an international scale. ISE and its associates maintain research laboratories in both hemispheres, and can supply your requirements through the facilities of 70 factories in 20 countries.

Complete Service—The Engineering Division of ISE will survey, plan, and estimate the cost of any project, regardless of size, from a single radio transmitter or component to the most complex installations embracing the latest in the art of communication, including line-of-sight and "over-the-horizon" microwave links. ISE supplies everything needed for such installations, from a screwdriver to an automatic telephone exchange, and including items not manufactured within the IT&T System. One of the most extensive and comprehensive catalogs of equipment and components is maintained.

Broad Experience—ISE and its affiliates have a record of experience since 1879. Telephone and telegraph systems have been installed in cities and countries all over the world. Pioneering developments of the International System include Tacan and other air navigation aids, microwave radio, electronic telephone switching, industrial television, and automation systems—proved in use in many lands and varying conditions of climate and terrain.

Your Headquarters—This combination of research, development, manufacture, sales, installation, maintenance, and operation on an international scale provides ISE with a unique position as your outstanding headquarters in the world of telecommunication and electronics . . . with a continuous record of service to the free world through periods of war or peace. Call on ISE for what you need, whenever and wherever you need it!



YOUR WORLD HEADQUARTERS

telecommunication

PRINCIPAL ISE SYSTEM PRODUCTS

WIRE COMMUNICATION

- Central office and private branch telephone and telegraph exchanges
- Toll dialing and switching systems
- Teleprinter exchanges
- Intercommunication systems
- Telephone and telegraph carrier systems
- Telephone sets
- Power-line carrier systems
- Teleprinters and facsimile equipment
- Coaxial cable systems
- Multi-conductor telephone cables
- Submarine telephone and telegraph repeaters

RADIO COMMUNICATION

- Television and radio broadcast transmitters and studio equipment
- Radio point-to-point equipment
- Microwave radio relay links, line-of-sight and "over-the-horizon"
- Mobile radio systems
- High-gain antennas

RADAR AND RADIO AIDS TO NAVIGATION

- Radar
- Direction finders
- Air navigation equipment
- Marine navigation equipment

ELECTRONIC SYSTEMS AND EQUIPMENT

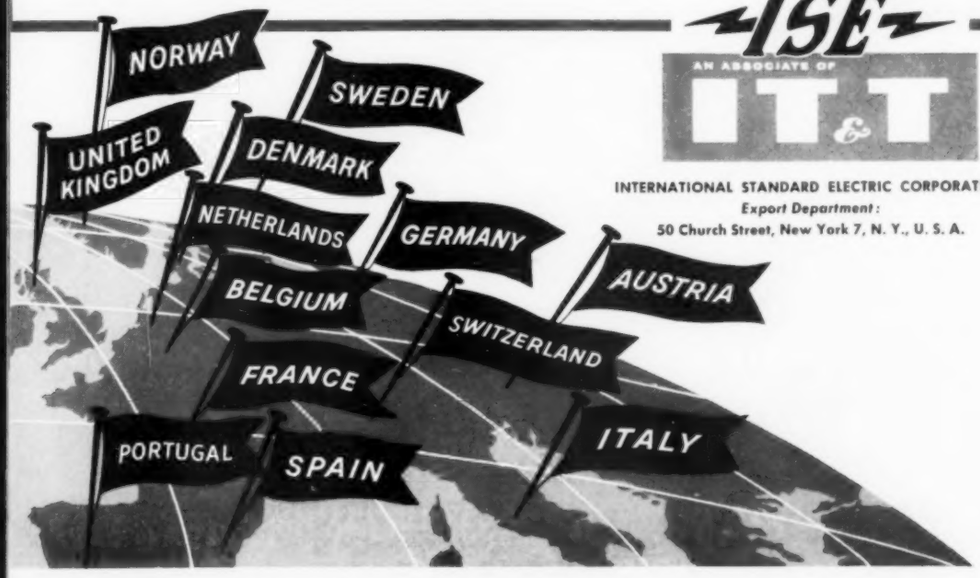
- Guided missile controls
- Electronic countermeasures
- Electronic computers
- Analog-to-digital converters
- Automation systems and equipment
- Automatic letter-sorting equipment

COMPONENTS

- Vacuum tubes
- Picture tubes
- Rectifiers
- Microstrip
- Transistors and diodes
- Condensers and transformers
- Fractional horsepower motors
- Loudspeakers

OTHER PRODUCTS

- Wire and cable
- Pneumatic tube systems
- Railway and power control, and signaling equipment
- Airport lighting equipment
- High-frequency welding equipment
- Public address systems



ISE
AN ASSOCIATE OF
IT&T

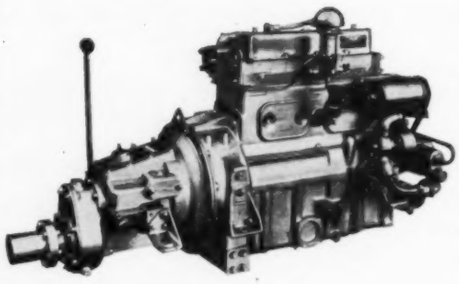
INTERNATIONAL STANDARD ELECTRIC CORPORATION
Export Department:
50 Church Street, New York 7, N. Y., U. S. A.

PERKINS DIESEL AND POWER STANDARDIZATION

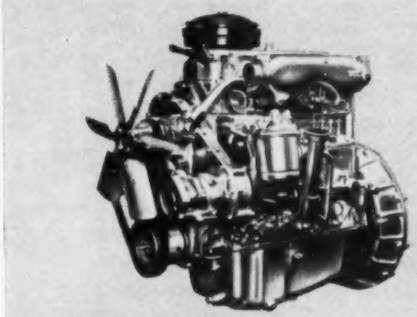
Wherever you use power—in the plant, on site, for transport or marine use, Perkins Diesel engines mean power standardization—and greater economy all round. Maximum interchangeability of engine parts means fewer spares, easier maintenance and quicker turn round on repairs. No wonder Perkins Diesels are at work on 423 applications, in 143 different countries. Perkins service is world-wide too. Perkins Overseas Companies and distributors and the manufacturers who standardize on Perkins' engines, ensure that Perkins Service and spares are readily available.

THE L4 (I) POWER PACK. This industrial power pack forms an extremely versatile unit which can easily be moved or mounted on a large variety of plant. The L4 (I) engine of 53 B.H.P. at 1,800 r.p.m. although extremely robust is not heavy. Approximate Shipping Specifications: The complete Power Pack weighs 1,450 lbs. net, 1,700 lbs. gross. Dimensions 5' 4"x 4' 10"x 2'.

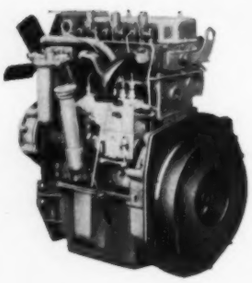
P6 (V) Automotive Diesel Engine



L4 (M) Marine Diesel Engine



P4 (I) Industrial Diesel Engine



P3 (TA) Tractor Diesel Engine

Full technical details of the Perkins range of diesel engines are available on request.

Perkins HIGH QUALITY DIESELS

The Diesel Engine with the Clean Exhaust

FOR INDUSTRIAL, VEHICLE, AGRICULTURAL AND MARINE APPLICATIONS

F. PERKINS LIMITED · PETERBOROUGH · ENGLAND

CAMCO

THE *Quality* LINE IN STAINLESS

"NET PRICE*" BULLETINS AND CATALOG AVAILABLE COVERING OUR FULL LINE

- **NP 856** — 150# Stainless Steel Screwed Fittings, Flanged Fittings and Flanges to MSS Standards, for standard pressure-service requirements.
- **XH-956-R** — Forged Stainless Steel 2000# & 3000# fittings for severe pressure-temperature applications.
- **BW-1056** — Schedules 5, 10, 40 & 80 Stainless Steel Buttweld Fittings to applicable ASA & MSS standards.
- **ASA-1056** — Forged Stainless Steel Flanges to ASA standards.
- **FCS-856** — Forged Lightweight Carbon Steel Back-Up Flanges for low pressure service requirements.
- **Catalog** — Includes pressure-temperature and corrosion resistant data.

* Replaces obsolete List Price and Discount Basis to eliminate unnecessary paperwork.

FILL IN AND MAIL *TODAY*

CAMCO Products, Inc., 445 State Street WP
North Haven, Conn.

Gentlemen — Please send literature checked below:

- ☐ ASA 1056 — Stainless Steel ASA Forged Flanges
- ☐ NP 856 — 150# Stainless Steel Pipe Fittings
- ☐ FCS 856 — Forged Carbon Steel Back-Up Flanges
- ☐ XH 956R — 2000#, 3000# Stainless Steel Fittings
- ☐ Catalog including pressure-temperature and corrosion resistant data
- ☐ BW 1056 — Stainless Steel Buttweld Fittings

Name .....

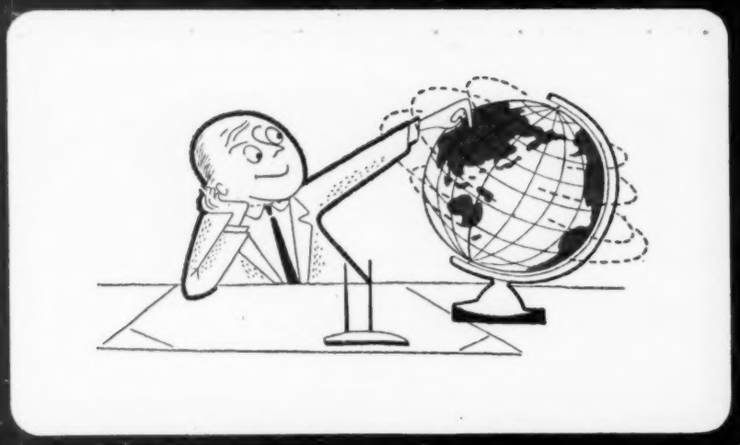
Company .....

Address .....

City ..... State .....

CAMCO PRODUCTS, INC.

445 STATE STREET
NORTH HAVEN, CONN.



THINKING OF PUTTING UP A PLANT, REFINERY OR MILL ON FOREIGN SOIL?

UNFAMILIAR CURRENCY MAY TANGLE UP YOUR FINANCES

AND NOT KNOWING THE LOCAL UNION RULES
CAN GET YOU INTO HOT WATER

WHY NOT TIE IN WITH LUMMUS SURE-FOOTED GUIDES
IN DESIGN AND CONSTRUCTION AT HOME AND ABROAD

LUMMUS HAS BRANCHES AND AFFILIATES AROUND THE GLOBE,
WITH EXPERT STAFFS THAT KNOW THE LOCAL SITUATION

YOUR LUMMUS-BUILT INSTALLATION WILL FUNCTION SMOOTHLY
YOU WILL GET MAXIMUM RETURN ON YOUR CAPITAL INVESTMENT

World-wide, world-wise Lummus has built more than 700 plants in the past half-century. Here is solid design and engineering experience that can work profitably for you anywhere. Whether you plan to build a chemical or metallurgical plant, petroleum refinery, paper mill or power plant or a new processing unit, Lummus provides the same integrated control in Bombay as it does in Beaumont. This can only lead to one conclusion for you—maximum return on your capital investment.

THE LUMMUS COMPANY
385 Madison Avenue, New York 17, N. Y.

LUMMUS

ENGINEERS AND CONSTRUCTORS FOR INDUSTRY

NEW YORK · CHICAGO · HOUSTON · THE HAGUE · LONDON · MONTREAL · PARIS

VOL. 28, NO. 3 MARCH, 1957

World Petroleum

THE MANAGEMENT PUBLICATION OF THE INTERNATIONAL PETROLEUM INDUSTRY

FOUNDED BY RUSSELL PALMER

Publisher MONA PALMER
Editor Emeritus E. W. MAYO
Editor J. C. CHATFIELD
Managing Editor G. H. BARROWS
Associate Editor ELOISE MICHEL
Production Manager A. V. HARCOURT
Art Director ITALO VALENTINO

Member of National Business Publications, Inc., and Business Publications Audit of Circulation, Inc.

SUBSCRIPTIONS

1 year, $10.00 2 years, $18.00
3 years, $25.00 Single copies $1.00

GENERAL OFFICES

604 Fifth Avenue, New York 20
(Tel. JUdson 6-4820)

BRANCH OFFICES

EUROPEAN OFFICE LONDON, ENGLAND

G. L. Fetherstonhaugh, St. Paul's Corner, Ludgate Hill, London, E.C.4.
(Tel. CITY 5318)

TORONTO 1, ONT., CANADA

Allin Associates 12 Richmond St. East
(Tel. EMpire 4-2001)

WASHINGTON, D.C.

J. B. Huttlinger National Press Building
14th and F Streets (Tel. EX3-3733)

LOS ANGELES 14

T. T. Drake 412 West Sixth St. (Tel. MUtual 1391)

NEW YORK 20

Sales Representative
E. L. Townsend
604 Fifth Avenue (Tel. JUdson 6-4820)

TULSA 3

O. F. Cozier, Mid-Continent Advertising Manager, 305 Daniel Bldg. (Tel. Diamond 3-1335)

World Petroleum is published by Mona Palmer, Trustee under the will of Russell Palmer

CONTENTS

4 Washington Pipe Line, *by Joseph B. Huttlinger*

6 Canadian Notes

8 Latin American News

47 Editorial—Why Pick on Oil

48 Search for Big Oil

52 Oil and Oceanography, *by T. F. Gaskell*

56 Weight Dropping—A Practical Seismic Tool on Land or Water, *by Alan Waldie*

60 Marine Sonoprobe, A New Seismic System for the Study of Recent Sediments

65 Field Techniques and Problems in Offshore Grants Program, *by Vance M. Lynch*

67 New Tools for the Geophysicist

68 Central Office Processing of Seismic Data, *by Hal J. Jones*

71 SSC Seismic Replay Center

72 SIE Record Analysis System

74 Carter Oil Laboratories Develop Field and Magnetic Machines

76 Geopac—An Automatic Plotter and Computer for Seismic Geophysical Data, *by L. M. Mott-Smith, W. J. Gendlach and G. C. Phillips*

84 The Gulf Seismic Profile System

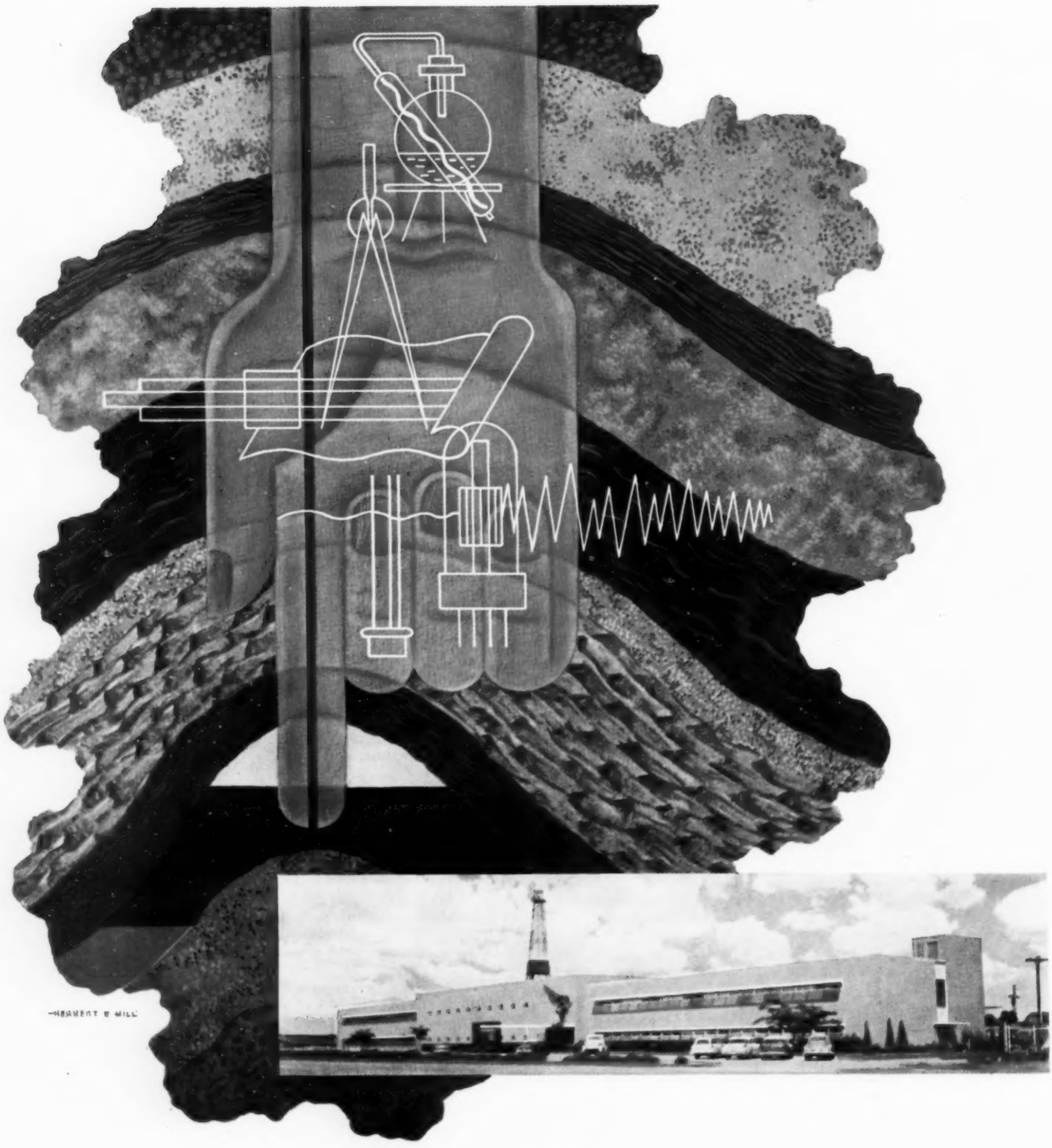
108 London Letter, *by E. Lawson Lomax*

116 International News and Notes

122 Oil Company Staff Changes

THIS MONTH'S COVER

In jungle territory as well as offshore the helicopter has become the workhorse of the oil explorer and producer. Pictured on the cover is an "egg beater" flying over the Colombian jungle. Photograph is by B. Newman for The Texas Company. Color plates are reproduced through the courtesy of Ellis Prudden, Editor of *The Texaco Star*. The pen and ink sketch of a ground crew afoot in the jungle was made by a WORLD PETROLEUM artist from one of Mr. Newman's photographs.



RESEARCH THAT SEARCHES . . . AND FINDS

Halliburton's extensive research programs are devoted exclusively to seeking . . . and finding . . . new answers to new problems and better answers to old ones, for the profitable production of oil and gas. Continue to LOOK TO HALLIBURTON for the foremost in applied technical advantages that are tested under field conditions.

HALLIBURTON OIL WELL CEMENTING COMPANY
DUNCAN, OKLAHOMA

Why Pick On Oil?

IT is the duty of any nation to consider the well being of its people and to take all proper steps to preserve their property and other fruits of their labor. The government of the United States is very properly concerned about any acceleration of the inflationary cycle. Expressions of government concern, however, should be aimed at sectors of the economy where inflationary pressures are greater than average.

Historically, the value of money has depreciated in terms of buying power for many centuries. The rate of inflation can be measured quite closely by the expansion of government activity and growth of the public debt. Money normally falls in value each year sufficient to pay the interest on the public debt. There have been cases in history where the debt itself has been paid off in a spree of wild inflation. Less severe inflation is incurred when borrowing from the banking system dilutes the value of money by creating too great a supply. This may be true whether the borrowing is by government or by industry.

At the moment, the United States government loudly is concerning itself with the price of oil as one facet of the inflation problem. Committees of Congress and the Executive Department are investigating the situation. This raises the question as to why oil should be made the object of attack, since it has been probably the smallest contributor to the inflationary spiral of any basic industry in the nation.

Oil has never been a large borrower of money. Early in its history, the industry was not able to obtain loans at favorable rates from the banking system. The result was that it adopted a policy of generating its own capital for expansion by retaining a large share of earnings. In 1955, for example, oil companies paid their stockholders only 44.4 cents out of every dollar of net earnings. The remaining 55.6 cents was plowed back into the business. Long-term debt of 42 large companies increased only $46.4 million, while net working capital rose $376 million and net capital assets $1,515 million.

Neither has the oil industry been guilty of contributing to inflation by advancing its prices at a rapid or reckless rate. It can be shown that prices have advanced less than on almost any commodity and are, in fact, lower than in earlier days when measured in terms of the purchasing power of the dollar.

If any criticism can be leveled at the industry on its pricing policies, it is that there has been a tendency to delay price adjustments too long. Take the steel industry as an example of a business which moves quickly when price changes are indicated. When new steel wage agreements are reached with union workers which affect costs, the steel companies advance their price schedules instantly.

Had the petroleum industry followed a similar policy, it would have advanced its price schedule nearly a year ago when the latest price advances in steel were posted and when labor was given higher rates. The amount of steel used toward making a barrel of oil is very large; drill pipe, casing, line pipe, tankage, refinery equipment, tankers—every tool used in the business—is a major consumer of steel. And in recent years the cost of oil equipment has risen about 9% per year. Labor costs also have roughly doubled the prewar rate. Oil prices have not.

The charge of collusion and monopoly is often leveled at oil, but those who do so overlook the very clear indications that the industry is highly competitive and not subject to control. Take the case of the most recent price increases. Humble Oil & Refining Co. advanced the price of crude when it could not buy enough oil in the open market to meet its needs. Other companies followed.

With higher raw-material costs, refiners advanced their prices for products. Then what happened? The price of gasoline promptly began to soften. The law of supply and demand began to operate within a matter of days. Gasoline stocks were high. Stocks exerted enough pressure on the market to wipe out most of the higher posting. Fuel prices have been more stable because stocks were low and demand was at peak levels.

The oil industry in the United States has an excellent defense against the current attacks leveled against it. It can well ask: "Why pick on me?"

Domestic producing companies and independent operators are pushing their exploratory activities into Central America, Venezuela, Alaska, Europe, the Middle East, Africa, and Asia in the worldwide search for new major oil fields.

search for BIG OIL pushed

STIMULATED by the Suez crisis and the destruction of Iraq Petroleum Co.'s major pipeline across Syria, the oil industry has intensified its search for "big" oil in other parts of the world. Africa, the Indian subcontinent, islands of the Caribbean, Central and South America are all being explored at an accelerated rate.

In the United States no major fraction of the two million barrels of surplus daily oil has been produced since the closing of the canal. This has been largely because of a shortage of pipeline facilities to deliver oil to the seaboard and the attitude of the Texas Railroad Commission. There are many engineers who are skeptical of the ability of the domestic industry to maintain an output two million barrels higher than the present level over any extended period even if the state regulatory bodies should remove the proration lid.

United States

Drilling operations in the United States are evidently heading for a new peak in 1957. The 58,160 completions during 1956 are expected to be exceeded by about 2,000 wells this year, with the total to be over 60,000. Exploration activities and wildcatting will expand due to the recent increase in crude-oil prices. The number of new wildcat wells in 1956 was 13,035, which is an all-time record for the industry—some 22% of all wells drilled. The increase over 1955 was about 5%, but the increase this year should be slightly smaller, since there is a considerable number of discoveries to be drilled up and the offshore work also calls for a smaller number of completions.

All is not oil that flows from the casingshead of a wildcat well. This photograph by Cornell Capa of Magnum Photos for Schlumberger Surenco was taken during a visit at Punta Arenas, Chile. It was reproduced by Schlumberger in its house magazine Intercom *under the caption: "But at least the water is very good."*

As reported elsewhere in this issue, leasing is active in Alaska and a wildcatting campaign is in prospect over the next few years.

Canada

Canada, which has not seen a major exploratory discovery since the Pembina field was found in 1952, has experienced a steadily increasing drilling program and a series of small, lucrative finds. Natural gas appears to be coming into its own, with the completion of the Westcoast Transmission line to the USA border opening up the upper areas of British Columbia. Phillips Petroleum Co. recently announced a significant Missippian gas discovery on its Kobes Creek prospect, 60 miles northwest of Fort St. John, British Columbia, where an intensive campaign is in progress to build gas reserves for export to the USA.

Completions in western Canada totaled 3,285 in 1956. Contractors and supply houses expect 3,600 new wells in 1957. These will be concentrated in the Pembina field of Alberta and the group of southeastern Saskatchewan fields.

Recently, Union Oil Co. of California hit flowing Granite Wash oil in a follow-up to its Red Earth discovery in northern Alberta. The original discovery well in this area was Union's Red Earth 12-16, which came in about one year ago at 792 b/d and touched off the biggest land play in Canada in recent years. It is located 1½ miles southwest of the new find. The Red Earth area is 85 miles east and 20 miles north of Peace River, and 230 miles due north of the Pembina field.

Mexico

Senator Antonio J. Bermudez, head of Petroleos Mexicanos, recently gave the number of wells drilled in Mexico at 410 during 1956. Average for the past 4 years has been 347. Total footage drilled in 1956 was 2,180,000 ft, an average of about 5,317 ft.

He stated that the number of new fields discovered in 1956 was 20, and that 59 new fields had been discovered in the past 4 years—with 88 oil and gas fields found since the expropriation in 1938. Reserves were estimated at 2,955 million barrels at the beginning of 1957. It would appear that extensions of known fields are included in the total of new fields reported by Pemex.

Recently, discovery of a new Mexican oil field, officially described as the most important since the 1938 expropriation, was announced during a recent flying visit of President Adolfo Ruiz Cortines and Senator Bermudez to the site at San Andres, some seven miles from Gutierrez Zamora on the right bank of the Tecolutla River in the state of Vera Cruz. The President opened the valves of the wells San Andres 3, which will have a production of 900 b/d; San Andres 8, with an estimated return of 1,300 b/d; and San Andres 2, with 900 b/d; and set in motion the drilling of San Andres 24.

Pemex technicians attending the ceremony predicted the new field will prove to be as important as Poza Rica, and added it possesses the advantage of being close to existing pipelines to refineries at Mexico City, Salamanca, and Tampico as well as to the port of Tuxpan. Construction of a 10-in. pipeline linking the new field with these lines is already under way.

San Andres 1 was brought in last June 19 in Cretaceous limestone. Total production of the 5 producing wells is 5,000 b/d. Wells completed to date are Nos. 1, 2, 3, 4, and 8, while drilling, at this writing, is still going on in No. 5, 6, 7, 11, 15, and 25. Producing interval is about 235 ft in thickness.

Central America

GUATEMALA

The general area of Central America is experiencing the greatest surge of exploration in its history. Interest has been shown in Guatemala for many years, but until

Two helicopters flying supplies to seismic survey crews in the Colombian jungle. Photo by B. Newman for The Texas Co.

recently it was retarded by an adverse political and legal climate. In the fall of 1945 an extensive survey of existing laws and conditions was made by Max Thornburg, at that time petroleum advisor to the US State Department. With the passage of workable legislation on July 7, 1955, a number of companies entered the country. Among those now in Guatemala and the acreage which they hold are the following:

Company	*Acres*
Sun Oil Co.	600,000
Tidewater, Atlantic, and Union	150,000
Ohio Oil-Texas Petroleum	891,800
Continental, Ohio, Amerada	394,000
Inversiones Guatemaltecas-Americanas	200,000
Story J. Sloan	97,940
Ohio, Standard of Calif., Union	650,000
Petrolera Calif. Ltd.	67,000
Petroleos Guatemaltecas	58,500
Esso Standard of Guatemala	250,000
Sohio Caribbean	400,000
Petroleum Investments Overseas (Shell)	500,000
Signal Oil & Gas, Ohio Oil, and Petroleos Guatemaltecas	102,765

British Honduras

Although various seeps and oil shows have been reported since the early 1900's, no exploratory wells had been drilled in British Honduras until British Honduras Gulf Oil Co., a subsidiary of Gulf Oil Corp., obtained exploration licenses covering the entire country and spudded Yalbac No. 1, near the border of Guatemala. The well was dry, and abandoned in the spring of 1956 at 9,003 ft. A second well, Hillbank No. 1, was drilled to 6,560 ft at a location north and east of the first. It was also abandoned with no shows. Total depth attained was 6,650 ft. The company has withdrawn its driller, and nothing is known of its future plans.

Honduras

A concession covering 48 million acres along the north coast was transferred to John W. Mecom and associates in 1956. Compania Petrolera Hondurena, former owner, retained a 15% interest. First exploratory well now is below 8,000 ft, and a second rig is to be brought in.

In 1956 a concession was granted to Lester Foran and Lynn S. Holmes covering 10.3 million acres. A year was granted for preliminary reconnaissance before drilling.

Nicaragua

Although the same Texas group which is interested in Cia. Petrolera Hondurena reportedly has been interested in Nicaragua, there is only one known concession, held by Miguel d'Escoto and Joseph Coney. It covers both sides of the country, including nearly the entire coasts, in three sections. There has been no known drilling on the concession, which was first taken out before World War II, and it is to expire in 1958 unless again renewed.

Costa Rica

Union Oil Co. will continue active drilling in Costa Rica this year in an effort to develop production in sufficient volume to warrant commercial operations. The first discovery in Central America of commercial proportions was made during 1955, when Cia. Petrolera de Costa Rica, a subsidiary of Union Oil Co. of California brought in Cocoles No. 1. Oil shows were encountered at 3,540 ft, the well was deepened, and further shows of light oil were encountered in limestone at 5,450 ft. The pay section was said to be 114 ft. The well was evidently somewhat off the crest of the structure and an offset, Cocoles No. 2, was spudded. The company announced a commercial discovery at 4,945 ft in porous limestone. Production averaged about 2,000 b/d of 46 API gravity oil. The well later began to flow salt water under severe pressure, and the well was allowed to flow in an attempt to exhaust the source of the water. The attempt was evidently not successful, and the well was described as noncommercial. The company has now spudded a third well, Cocoles No. 3, higher on the structure.

Panama

An exploration rush is on in Panama occasioned by the recent Union discovery in Costa Rica. Union Oil Co. has a contract for exploration and exploitation covering about 280,550 acres, and numerous local companies hold large concessions.

Cia. Petrolera del Golfo del Darien, an affiliate of Commerce Corp., of New York, has a concession covering 16 million acres in southeastern Panama, including the province of Darien and a large section offshore in the Golfo del Darien. A share in the concession is held by International Oil and Metals Corp., of San Francisco. A core-drilling program is planned by International.

Other companies known to be exploring in Panama, under surface reconnaissance permit only, are Aluminum Co. of America, Utah Construction Co., New York

Seismograph cables being joined by connectors during operations in Alberta, Canada. Photo by Corsini for Standard Oil Co. (N. J.)

Honduras and Rosario Mining Co., and Union Oil Co. of California.

A new company, the Caribbean American Petroleum Corp. of Panama, has been formed by Texas American Oil Corp., of Midland, Texas, to obtain concessions in the country. It is headed by Nash Dowdle.

Two companies reportedly obtained concessions recently, but the reports were denied by the government of Panama. They are Consolidated American Industries Inc., which has applications for a large area, and Cataract Mining Corp., of New York.

Union Oil Co. is now drilling a well just across the border from its Costa Rican discovery. The structure is apparently the same.

Colombian jungle kitchen preparing chow for a Texas Petroleum Company seismic crew. Photo courtesy The Texaco Star.

South America

Venezuela

The expected upswing in Venezuelan exploration which was expected when the new concessions were granted has not yet begun, since the companies need considerable time to gear up to lake operations, and the most promising of the new concessions are in Lake Maracaibo. A new development in the lake was Mene Grande's discovery, Ceuta No. 1, which came in from about 8,000 ft which establishes a new zone of production in the lake. Venezuelan Leaseholds, one of the new concessionaires, has a holding immediately adjacent to the discovery.

Considerable interest has been manifested in the discovery at Aguasay 3-1, brought in by Venezuelan Petroleum Co., an affiliate of Sinclair Refining Co. The well is located not far from Sinclair's Santa Barbara field in the Greater Oficina area of western Monagas province, eastern Venezuela. It produced 27,000 b/d of 36 API crude in the first 25 days from Oficina sands of good porosity of Oligocene age. The "T" and "S" sands are producing at present. The "T" sand, 50 ft thick and producing 687 b/d, came in at 1,355 ft. The drillers came up about 100 ft, and perforated the "S" sand for around 600 b/d. There are at least six other sands indicated on the electric log which as yet have not been tested. Structure maps indicate about 900 acres (depending on geology) of productive area.

Aguasay 3-1 is located about 27 miles from the Santa Barbara-La Cruz 16-in. pipeline, owned one-third by Sinclair. An 8-in. connecting line is planned. Another wildcat, Aguasay 4, was drilling at 13,000 ft as of February 1, about 4 miles due west. Aguasay 1 and 3 are about 3 miles south. No. 1 was a producer at about 100 b/d; No. 3 has gone mostly to gas. An offset to the discovery, Aguasay 3-2, is now testing.

The properties of Pancoastal Petroleum Co. immediately adjoin the location, and Pancoastal is drilling an offset well to the discovery—with Atlantic Refining Co. contributing 50% and acting as operator. The Pancoastal well was past 13,000 ft early in February and drilling ahead slowly. No shows were reported.

Colombia

During 1956 several important exploratory wells were begun. Empresa Colombiana de Petroleos spudded Quebrada Roja, a wildcat well in the northern area of the De Mares concession, which is now drilling. Colombian Petroleum Co. is drilling No. 1 Esperanza in the Mercedes area south of its Barco concession, and Texas Petroleum Co. has a well going on the Caipal discovery north of its Velasquez field. One of the major discoveries during 1956 was Colpet's (Colombian Petroleum Co.'s) Cicudo discovery drilled to 8,115 ft, which tested initially about 300 b/d of 43 API crude. This brings a new area to the attention of explorers, on the coastal plain. Intercol (International Petroleum Co.) drilled Campeche No. 1, during late 1956, with Mobile Oil Co. Intercol is drilling 2 wildcats 60 miles southwest of Bogota, and is doing reconnaissance work in the eastern Llanos.

In order to speed exploration, the government promulgated a decree which obliged the oil companies holding areas under option either to sign exploration contracts over the areas or release them by August 31, 1956.

International Petroleum (Colombia) Ltd. has abandoned its Raspe No. 1 at about 5,000 ft, a wildcat spudded about 10 miles north of Girardot, 60 miles southwest of Bobota. The company has since spudded two additional exploratory wells, at Gualanday and El Espinal.

(Continued on page 96)

Difficult terrain in the Rub'al-Khali desert of south-central Arabia is explored with vehicles equipped with special under-inflated sand tires that "float" over the sand. Photo courtesy of Arabian-American Oil Co.

OIL AND OCEANOGRAPHY*

By Dr. T. F. Gaskell

DR. T. F. GASKELL studied physics at Cambridge University, England, where he graduated in 1937. He gained his Ph.D. degree after studying geophysics at Cambridge under Sir Edward Bullard, FRS. His thesis was written on application of seismic refraction work to study detailed geological problems, and on early refraction measurements at sea on the structure of the continental shelf.

After war service with the British Admiralty on all aspects of underwater weapons, he joined British Petroleum to serve three years in the Persion oil fields. A three-year leave of absence was granted for Dr. Gaskell to lead the worldwide oceanographic expedition of H.M.S. "Challenger," during which seismic measurements were made in the deep oceans of the world. On returning to British Petroleum, he spent three years in the geographical research department, and recently has been appointed senior physicist of the Exploration Department.

The science of oceanography has much in common with physics of the oil industry. Offshore prospecting methods are similar to those used to study the structure of the continental shelves and of the deep sea floor. The British refraction technique using sono-buoys may be useful in some marine geophysical work. Methods of interpretation of gravity, seismic, and magnetic measurements developed by oceanographers may be applicable in oil exploration, and a better understanding of echo sounding is allied to seismic reflection studies. The wave and current investigations are required for designing of offshore structures, and marine biological observation and core sampling of the sea bed are closely related to studies on the formation of oil. The oceanographer and the oil man have much in common also in being both interested in observations of physical phenomena several miles below them and the instrumental techniques developed, for one will apply to the other.

Most people in the oil exploration business must have encountered some aspect of oceanography in the course of their work. It is in offshore prospecting that geophysicists and oceanographers have common ground, but the research carried out in the seas is important to the oil industry in many other ways. I have worked as a physicist both in oil fields and in research ships, and I hope it may be of interest to you to hear about the types of measurement which are being made by oceanographers in Great Britain. I was fortunate last summer to be invited to join an Atlantic cruise of the Royal Research Ship Discovery II, operated for the National Institute of Oceanography. Most of the three-week period during which I was on board was spent in the deep water between the Azores and Madeira, and the calm weather which prevailed allowed a wide variety of experiments to be made.

The seismic method, as on land, is one of the most powerful tools used to investigate rock structure of the sea bed. In deep water there is no geological control from bore holes or outcrops and, therefore, refraction seismic is commonly used. Although reflections have provided useful measurements of sediment thickness, it has been desirable to identify the layers of the earth's crust and, if possible, to correlate layers beneath the ocean with those under continents. Therefore, it has been necessary to label them by their seismic velocities. Furthermore, as recent work in such areas as the Canadian foothills has demonstrated, refraction is very useful to give a regional picture in a new area.

The British seismic work at sea was started by Sir Edward Bullard in 1937,[1] and the early measurements were made with conventional land equipment made waterproof and laid on the sea bed. A hydrophone was used to record the water waves, which are used at sea to measure the shot-point geophone distances; and some faint arrivals at this hydrophone, preceding the water wave, suggested that a hydrophone near the surface could record ground waves which had traveled in the sea bed. Dr. M. N. Hill[2] developed this idea after the war, and found that good ground waves could be recorded in deep ocean water, where prohibitive lengths of cable would be needed to operate geophones placed on the sea bed. Professor Ewing independently developed similar methods, in which a hydrophone in one ship recorded waves from shots fired from a second ship. In order to be able to work with one ship, Dr. Hill combined his hydrophone with a radio-buoy. In this way he gained a great advantage, because a line of several buoys could be operated at once to provide at each shot a set of time-distance readings. Although this does not eliminate the need for reversal of a refraction line, it limits the ambiguity of the results, a fact normally made use of on land.

The sono-buoys have been thoroughly described in other papers. A crystal hydrophone is suspended some 150 ft below a buoy which contains an amplifier and radio transmitter. Frequency modulation is used to avoid spurious signals which, with amplitude modulation, would be produced by movement of the aerial. The original sono-buoys were a few hundred pounds in weight; but the latest version, used this year in *Discovery*, are small enough to be handled by one man. The radio range of the buoys is of the order of 20 miles, and in the deep-oceans refracted waves at this distance are obtained with charges of the order of 100 lb.

The sono-buoys are well suited in refraction work in shallow water. In 1951, for example, we investigated the subsurface structure in the lagoon of Funauti atoll[3], where the depth of water was about 120 ft. The buoys were towed into position by motor boat, and were anchored in line. Shots, up to a maximum of 20 lb at 30,000 ft, were fired at various distances; and it was possible to complete a whole reversed line of shots in one day. There is no need to drill shot holes in water, and accurate surveying is dispensed with because each hydrophone measures its own shot distance by means of the water wave. In these par-

* *Presented before the 26th Annual Meeting of the Society of Exploration Geophysics, New Orleans, La., October 31, 1956. Publication is by permission of the editors of* Geophysics *magazine.*

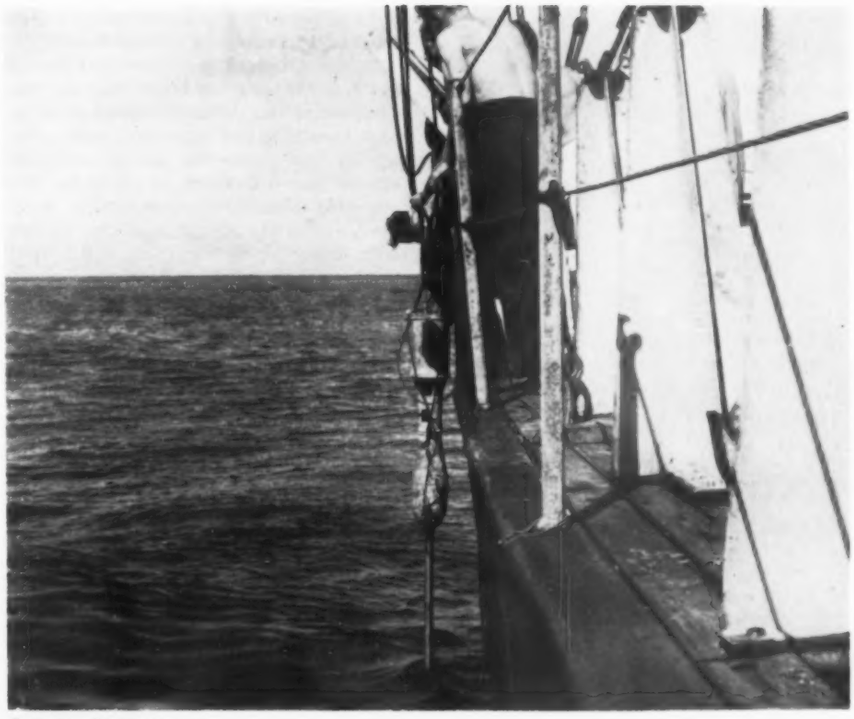
ticular experiments the recording was carried out on the ship which was anchored in the lagoon near the line of sono-buoys; but, for offshore work, it would be equally effective to have the recording base onshore. A small boat only is required to anchor the buoys and to fire the shots. Sono-buoys are clearly adaptable to shoot arcs as well as lines.

Sono-buoys are not only means of obtaining refraction results in shallow water. I was pleasantly surprised to find that the hydrophone streamer of M.V. "Sonic" could be used in a similar manner in the Persian Gulf. Although the frequency response of the reflection gear is rather high for the main 10 cps to 20 cps frequency components of ground waves in deep water, easily recognizable arrivals were obtained with charges of up to 240 lb in about 80 ft of water. It is possible that multiple reflections between sea surface and sea bed produced trains of arrivals having main frequencies higher than normal; but, whatever the cause, it was possible to locate a high-velocity refractor at considerable depth. The whole line of 50,000 ft, with several reverse shots, was completed in one day. There is no doubt that the uniform close spacing of a reflection outfit is of great assistance in recognizing refracted waves in face of background noise. Furthermore, automatic gain control helps in observing refracted waves before they become first arrivals, and this second-event technique will be improved by the developments currently being made to read seismic records by cross-correlation of separate geophone traces.

In all seismic work at sea, the topography of the sea bed must be measured in order to correct the travel times of refracted waves. The echo-sounder in deep water has many similarities to reflection shooting on land. In both cases the effective beam angle of the instruments is large, so that observed reflections do not necessarily come from the reflecting layers vertically below the recording point. The complexities of record produced by side reflections and the smoothing of subsurface features may well be studied in both cases by model work, and both oceanographers and geophysicists may assist each other in this respect. It is interesting to see that, in reflection shooting, new methods of display of records—sometimes with variable intensity as is used in echo-sounder records—are aiming at a straight echo-profile of underground rock layers.

The seismologist working in the deep oceans, of course, is not primarily concerned with improving offshore prospecting, but the results he obtains of earth crustal structure make a fundamental contribution to geological thought. This contribution is not merely of interest in fitting the two-thirds of the earth's crust which is covered by oceans to the continents, in order to provide a more accurate understanding of the past history of rocks, but it is doubly important because it is on the fringes of land masses that things are happening today; i.e., rocks are being laid down, and possibly oil is being formed.

Camera being lowered.



Lowering the corer.

Dr. J. C. Swallow and Dr. T. F. Gaskell listening for breaking of glass ball when corer strikes sea bed.

Temperature probe about to be lowered to the sea bed.

Dredge ready for towing.

The other geophysical methods of locating oil structures are used at sea. Gravity observations are difficult because a ship provides only a very unstable platform from which to make measurements, but for many years now successful results have been obtained by swirling pendulums in a submarine. Some recent developments of gravimeter for use at sea, notably those of Lacoste and Haalck, may have application one day in offshore work.

Magnetic measurements recently have been made in the oceans. Since many of the topographical features of the sea bed appear to be volcanic, it is hoped that magnetic anomalies will be useful to discover similar features which are covered with a flat layer of sediment. The air-borne fluxgate type of magnetometer has been used in the Pacific, and this year the new Varian proton, or water-bottle, magnetometer has been adapted to be towed behind a ship.

This instrument, made by Dr. Hill[6] of Cambridge University, gave excellent results in the Atlantic. It possesses the great advantage of requiring no calibration other than the standard provided by a crystal clock, and it is far less bulky than the fluxgate device. The sea-going proton magnetometer would appear to be very suitable for towing while shooting seismic reflection lines offshore, in those places where it is desirable to differentiate structures which have volcanic material near the surface from those which are thick sedimentary uplifts.

Another oceanographic measurement which may tell us more of the volcanic history of the sea bed is that of heat flow. The Bullard[7] probe is used to give a record of the temperature difference at two points 15 ft apart vertically in the sediment of the sea bed. By combining this temperature gradient with the conductivity of the sediment, as determined in the laboratory on cores obtained from the sea bed, the heat flow through the earth's crust can be calculated. Normally, the heat flow is of the same order of magnitude as that observed on the continents—a somewhat surprising result, because other evidence suggests that the rocks beneath the oceans should contain less radioactive heat-producing material than the granite beneath continents. Abnormally high results found occasionally in the deep ocean probably indicate that recent volcanic activity is nearby.

Core samples of the sediment of the sea bed are not collected merely for heat-conductivity measurements. The constitution of these cores, both stratigraphically and chemically, helps to build up a picture of what the oceans were like in past ages. It may be that the red clay found in water more than three miles deep will show what trace elements have been falling on the earth from the outer atmosphere; and these trace elements, in turn, may help to classify or even tell the ages of oils formed in shallower water, where the sediment picture is confused by material brought down from the land, and by large quantities of dead marine life.

Any fundamental work on the origin of oil will be well spent, for it may assist in telling where to look for oil, and possibly in some areas where to look for oil of a desirable quality. The work of Smith[8] and of Stevens[9] in extracting hydrocarbons from Gulf sediments has shown that some hydrocarbons have been formed recently. The logical next step for this work is to take more interest in the biological side of oceanography, and to study the areas where abnormal growth of animal life is present. Oil is not found in vast quantities everywhere, and we cannot hope to find its being formed in all places where sedimentation is taking place now.

The old 19th century method of sampling the ocean bed by dredging still yields useful results. Today the dredge is used to assist in the interpretation of photographs of the sea bed taken with an underwater camera. The National Institute of Oceanography's camera, developed by Dr. A. S. Laughton,[10] has obtained successful pictures in depths of 15,000 ft. The camera can take about 25 photographs on 35-mm film; separate shots are obtained by repeatedly lowering the camera assembly until a foot-weight strikes the bottom and trips the flash light, and then raising a few feet until the foot-weight is hanging free. An oscillator fitted to the assembly sends a signal to a surface

Feeling line to make sure dredge is on bottom.

Oceanography—the Azores: Examining rocks from dredge.

hydrophone once a second when the footweight is free, and the signal rate increases to five a second when the weight strikes bottom—thus enabling control of the lowering winch on the ship.

Photography of the sea bed may be rather far removed from oil in one sense, but the instrumentation required for this type of apparatus is very similar to that used in petroleum engineering. Petroleum engineers and oceanographers have both to measure physical properties at depths of several miles and at great pressures. The cable developed for well logging may well be useful to the oceanographer, and techniques of handling apparatus in deep water may give useful ideas for oil-field measurements.

Another common ground which the oil industry has with oceanography is in the measuring of waves and currents of the sea, and the erosion effects these have on coast lines. Apart from the navigational aspects as they apply to the transport of oil in tankers, there is a very real use in the construction and operation of loading jetties and offshore pipelines. Now that a great deal of drilling is being done in shallow water, the knowledge of wave forecasting amassed during the war for landing operations is proving of inestimable value, both in designing structures capable of resisting the largest waves which may occur and in providing forecasts of weather which permits small-boat operations for supply purposes. The National Institute of Oceanography has been in the forefront of wave research, and now has a ship-borne wave-measurer[11] which has great advantages over the fixed devices used previously. The mobile type of wave recorder allows us to find quickly the peculiarities of an offshore area which produce abnormally large or small waves, and this information is just what is needed to supplement the general regional wave forecasts made from meteorological data.

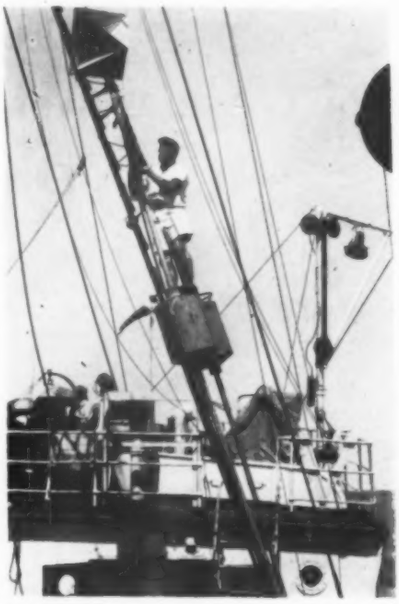
There is one recent development in British oceanography which indirectly may provide useful ideas. The currents in deep oceans are small—of the order of a few miles a day in some cases; but they are important because the circulation of water in the seas is important in its effect on climate and on marine life. These currents in the past have been calculated from determinations of salinity and temperature of sea water at various depths. Direct-current measurements now can be made with Dr. Swallow's[12] apparatus, which is a signaling device which can be set to float at any desired depth. The "pinger," as it is called, is positioned relative to a moored buoy by taking bearings on hydrophones placed in the ship and at the same time locating the ship relative to the buoy by radar. The buoy moored in water three miles deep is not truly a fixed reference point, and the position of the buoy is checked at intervals by surveying a patch of sea bed, chosen to have some conspicuous topographical features. The surveys are all related by radar fixes to the buoy and, by matching the bottom topography from one survey to the next, the movement of the buoy can be obtained. This method of using fixed marks provided by nature well may have application in some offshore work where land fixes are not possible and where such navigational aids as Decca are not available.

These examples of the common ground of oil production and oceanography well may suggest more spheres of activity where overlap of interests occurs. It is not surprising that this should be so because, apart from sea-going oil operations, both oil man and oceanographer are finding out what nature is hiding several miles below the surface. END

REFERENCES

1. Bullard, E. C. and Gaskell, T. F. (1941) *Proc. Roy. Soc. A. 177*, 476-499.
2. Hill, M. N. (1952) *Phil. Trans. Roy. Soc. A. 244*, 861.
3. Ewing, M., Worzel, J. L., Hersey, J. B., Press, F., Hamilton, E. R. (1950) *Bull. Seis. Soc. Amer. 4*, 233-242.
4. Gaskell, T. F., and Hill, M. N., *Penguin Science News 29*, 7-31.
5. Gaskell, T. F., and Swallow, J. C., *Occasional Papers of the Challenger Society*, London, No. 3.
6. Hill, M. N., in publication.
7. Bullard, E. C. (1954) *Proc. Royal Soc. A, 22*, 408.
8. Smith, P. V., *Bull. A.A.P.G. 38*, 377.
9. Stevens, N. P., et al. (1956), *Bull. A.A.P.G.*, 975-983.
10. Laughton, A. S., in publication.
11. Tucker, M. J. (1956) *Trans. Inst. Nav. Archit.*, London.
12. Swallow, J. C., *Deep Sea Research 3*, 74-81.

Proton magnetometer.



Fitting up radar reflector buoy.

Oceanography—the Azores: Pinger going overboard.

Sono buoy being laid.

Sono buoy.

NEW TOOLS FOR THE GEOPHYSICIST

ALAN D. WALDIE, Chief Engineer for McCollum Exploration Company at Houston, Texas, was graduated from Texas A & M College in 1951 with a B.S. degree in Electrical Engineering. After two years as a U.S. Army Signal Corps officer he joined the McCollum Company in 1953. He is a member of the S.E.G. and I.R.E.

Dropping a 6,000-lb weight from a height of only 9 ft in certain difficult areas has produced vertical energy records at costs below conventional seismic methods.

WEIGHT DROPPING *a practical seismic tool on land or water*

*by Alan Waldie**

THE weight-dropping technique is a new exploration tool backed by 16 years of research and development and 3 years of practical commercial experience to help solve, economically, the present-day problems of exploration geophysics.

There has long been a need for a fast, flexible, and economical seismic system to help solve the problems of obtaining good readable seismic reflections from "poor record" areas. In certain parts of West Texas, Oklahoma, Florida, Mississippi, and other areas where horizontal energies or multiple reflections tend to obscure or obliterate the desired vertical energies, the weight-dropping technique can be an invaluable aid.

REMEDIES: The weight-dropping technique is the first system to be introduced in recent years as a method to aid in relieving the aforementioned problems, while at the same time reducing the cost per profile-mile of exploration by eliminating the costs of shothole drilling and explosives, and in many instances by increasing the daily subsurface coverage.

The mere dropping of a weight, instead of shooting dynamite, does not in itself eliminate the problems of obtaining good records in "bad" areas. Weight-dropping techniques, when used in conjunction with a highly specialized system of FM magnetic tape recording in the field, as well as precision processing with laboratory instruments and apparatus which have been designed to record, process, and integrate the weight drops into usable photographic seismograms, usually will produce the desired results. Getting usable data involves special field and laboratory techniques of handling the weight-drop information so that the signal-to-noise ratios of these recordings are improved to the extent that desired data are obtained while undesired characteristics are removed or reduced to a minimum. Fig. 1 shows the weight-dropping unit mounted on the rear of a large truck for mobility of operation. The weight which it drops weighs 6,000 lb; and, when dropped from a height of 9 ft to the ground, creates an impact power of about ½ oz of 60% gelatin dynamite.

Fig. 1 Weight-dropping truck with the 3-ton weight which has just been dropped: The chains at the rear are to guard against personnel walking under the weight.

*Chief engineer, McCollum Exploration Co., Houston, Texas.

However, the elastic energy created is equivalent to about 2½ lb of the same explosive.

VERSATILITY: The mechanism which hoists and drops the weight is constructed so that it can be mounted on almost any suitable vehicle capable of carrying it through the area under survey. In the case of dry-land operation, it is mounted, as mentioned, on the rear of a truck. For offshore operations, the unit is placed on a special barge (Fig. 2) which has a "well" cut through the center of the deck for dropping the weight. If marsh or swamp were to be surveyed, it would be possible to build a weight-dropping mechanism on articulating pontoons, pulled around the area by marsh buggies.

FIELD PROCEDURE: To understand more fully the various processing and integrating operations required in the weight-dropping system, an explanation of field procedure should first be made. A typical weight-dropping crew consists of a party chief; an instrument operator and assistant; a weight-truck operator and driver; a surveyor, and one or two assistants; a wireman; and four to six detector patch men. After the survey crew has laid out an area to be explored, and the detector patches have been laid out, the weight truck is put into position. Drop intervals along the line depend on detector station intervals to be used in an area. Normally, 1,000-ft or 1,500-ft station intervals are convenient—which would mean drops at 21-ft or 31-ft spacings, respectively, along the line of survey to give a total of 96 drops per setup.

Fig. 3 shows one field procedure which can be used with 2 detector patches spaced 2,000 ft apart, using a 1,000-ft station interval and a 21-ft drop interval. This field procedure combines split-spread and extended-on-line methods, and normally is used only when very accurate velocity control is available for correctional purposes. Generally, either a split-spread or an extended-on-line method is used.

Each patch consists of a large number of geophones connected in a series parallel arrangement to one geophysical amplifier per patch. Two patches and dual recordings are used at a time in order to make subsurface coverage equal to drop coverage on the surface. Patch "A" is placed on station 2; patch "B" is placed on station 4. The weight truck starts at station 1. As the weight truck moves in 21-ft intervals from station 1 down the line, the weight is dropped by radio control from the recording truck at 12-sec to 16-sec intervals.

As drops are made from stations 1 to 2, patch "A" records subsurface a_1, and patch "B" records b_1. From stations 2 to 3, patch "A" records a_2; patch "B" records b_2. Patch "A" is now connected in at station 6, and patch "A" is disconnected. Dropping from stations 3 to 4, patch "B" records b_3, and patch "A'" records a'_4. From stations 4 to 5, patch "B" records b'_4, and patch "A'" records a'_5, etc. This process continues until the line under survey is completed.

There are several field-procedure variations used, depending upon existing condi-

Fig. 2 A special barge, 25 ft x 60 ft, constructed for water operations: The weight is dropped through a well in the center of the barge.

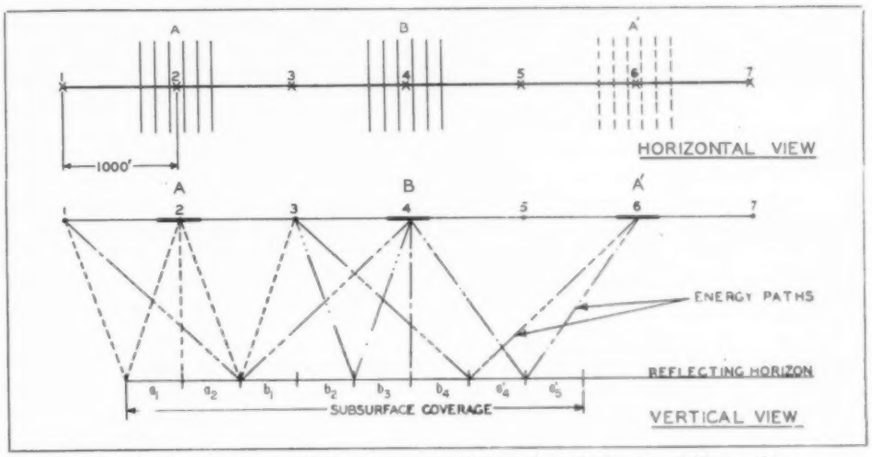
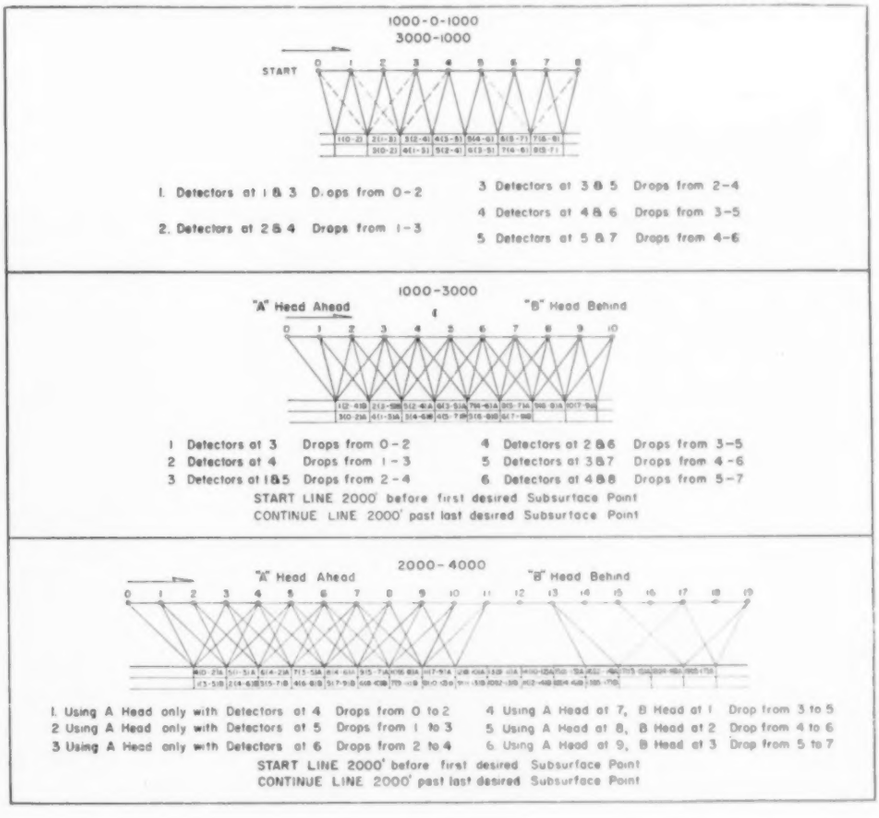


Fig. 3 Diagram showing horizontal and vertical view of weight-dropping field procedure.

Fig. 4 Diagram showing double-coverage method of field procedure.


1000-0-1000
3000-1000
START
1. Detectors at 1 & 3 Drops from 0-2
2. Detectors at 2 & 4 Drops from 1-3
3 Detectors at 3 & 5 Drops from 2-4
4 Detectors at 4 & 6 Drops from 3-5
5 Detectors at 5 & 7 Drops from 4-6
1000-3000
"A" Head Ahead
"B" Head Behind
1 Detectors at 3 Drops from 0-2
2 Detectors at 4 Drops from 1-3
3 Detectors at 1&5 Drops from 2-4
4 Detectors at 2&6 Drops from 3-5
5 Detectors at 3&7 Drops from 4-6
6 Detectors at 4&8 Drops from 5-7
START LINE 2000' before first desired Subsurface Point
CONTINUE LINE 2000' past last desired Subsurface Point
2000-4000
"A" Head Ahead
"B" Head Behind
1 Using A Head only with Detectors at 4 Drops from 0 to 2
2 Using A Head only with Detectors at 5 Drops from 1 to 3
3 Using A Head only with Detectors at 6 Drops from 2 to 4
4 Using A Head at 7, B Head at 1 Drop from 3 to 5
5 Using A Head at 8, B Head at 2 Drop from 4 to 6
6 Using A Head at 9, B Head at 3 Drop from 5 to 7
START LINE 2000' before first desired Subsurface Point
CONTINUE LINE 2000' past last desired Subsurface Point

tions of the area to be surveyed. Through-the-patch or "split" spreads of 1,000'-0-1,000', or 1,500'-0-1,500', are quite effective in many areas (Fig. 4). In other areas, extended-on-line spreads of 2,000 ft to 4,000 ft and 4,000 ft to 2,000 ft are more effective. Combinations of the "split" spread and extended-on-line spread can also be used as discussed above and illustrated in Fig. 3. Since experience has shown that a high diversity factor in both drop and recording patterns generally will produce the best results in any area—particularly those difficult areas classed as approaching "NR" for conventional equipment—a special circular drop pattern has been developed for these "problem areas" (Fig. 5).

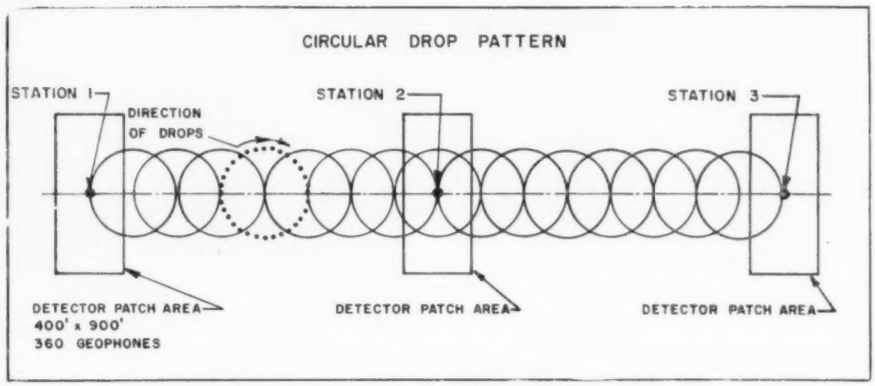


Fig. 5 Diagram of a circular drop-pattern method of field procedure.

Circles 500 ft in diameter require a drop interval of approximately 16 ft. There is a 250-ft overlap of the circles, providing about 50% ground overlap. The 96 drops for each circle are corrected for variation in drop time and elevations, and then integrated into one trace. A record consists of 15 traces when 2,000-ft station intervals are used, and the eighth trace is the reference trace for the subsurface datum below the detector patch station.

The size of the circles can be reduced, as can the number of drops per circle. In some areas, terrain conditions make 500-ft-diameter circles difficult to obtain. Reducing the number of drops increases production slightly. Dual-head recording increases the daily production obtainable.

Patch dimensions are generally large for West Texas areas, and small for Gulf Coast areas. The number of detectors per patch is variable with the area; but, in West Texas, 360 detectors are adequate in most instances, whereas 60 detectors appear to be a good number for Gulf Coast work.

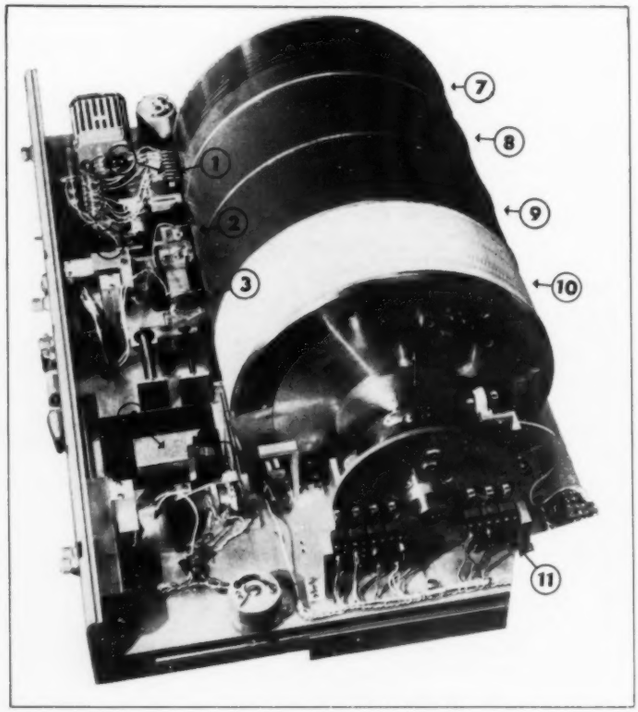
Automatic gain control in the field recording, coupled with tapered suppression control during the processing, gives excellent results. AGC during the processing will also give acceptable results.

The instruments which record seismic energy generated by the falling weight are synchronized with the weight unit by radio in order to record sequentially the individual weight drops and to store this information for further processing.

It should be noted that, in any operation using the weight-dropping technique, there are variations in the actual time-of-fall due to: variable release time, variable friction in the release mechanism, variable height-of-fall due to surface irregularities, and variations in the degree of compaction of the ground, as in a plowed field, etc. In order to record sequentially the vertically-traveling energy with each weight drop, as though no variation in the time-of-fall existed, all of these variables must be compensated for as though there were no drop-time variation. To do this, it requires that each drop time be accurately measured for proper compensation. As the weight is released, a timing circuit is actuated to measure time until an inertia switch, mounted on the weight, triggers on impact of the weight and stops the timer. This timing device is a part

Fig. 6 Field instruments in a panel truck, showing a magnetic tape being loaded for recording.

Fig. 7 Field recording instrument with covers removed: (1) primary record-playback heads; (2) record head—"A" patch; (3) record head—"B" patch; (4) inking-pen galvanometer; (5) servo motor; (6) eight-head bank; (7) primary drum 1; (8) patch "A"—drum 2; (9) patch "B"—drum 3; (10) monitor drum 4; (11) micro switches.



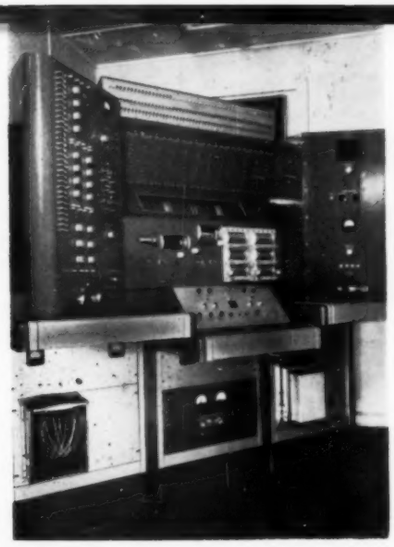


Fig. 8 Universal Analyzer—central-office magnetic-tape integrating record-playback equipment.

of the field recording instrument mounted in another truck.

The field recording instrument is mounted in an airconditioned panel truck which also houses the radio equipment, monitoring devices, and test equipment necessary for field operation. The recording equipment is an FM magnetic tape recorder designed to record magnetically the seismic energies created by each weight drop (Fig. 6).

It records these data, corrects for the drop-time variations, and, if desired, can integrate this information into 4 drop pre-composites on each of its 48 seismic tape tracks. Fig. 7 shows the equipment as it is mounted in the recording drum transport of this unit, with its covers removed. Three of the four drums shown are used to hold 4-in.-wide magnetic recording belts which store the seismic data. The fourth drum is used as a monitor drum, and holds prelined monitor paper for the pen motor recorder. Drum 1, or the primary drum, has 8 record-playback heads (*1*) which are connected to a servo mechanism for drop-time correction. These heads make the primary weight-drop recordings.

The weight is dropped from the instrument truck by radio control, since the time of release must be coordinated as a function

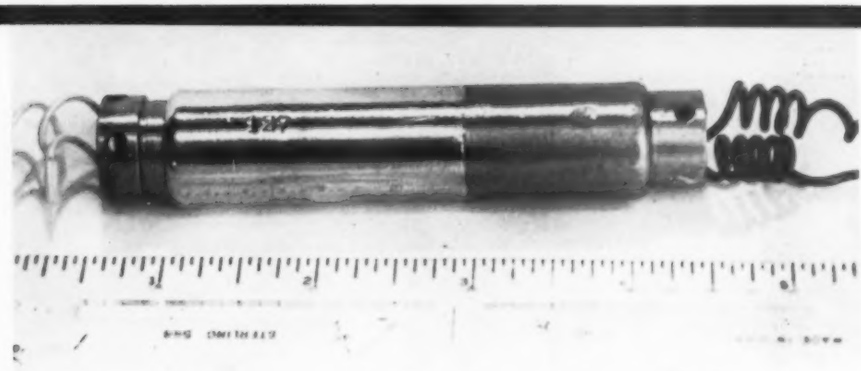


Fig. 10 New miniature self-orienting electrodynamic geophone, used in land cables for high-speed production.

of the revolution of the tape-holding drums. Each tape drum will hold 24 of these 4-drop composite tracks, or a total of 96 drops. After these drops are stored, the tapes are removed from the drums, blank tapes put in their place, and the sequence continues.

The monitor paper drum (*10*) is used by the operator for making inked-pen motor monitor playbacks from the tapes in order to visualize what has been recorded. Also, weathering information is recorded directly from a special geophone string to this monitor for control correction data to be picked and applied during processing as a static-time correction. In addition to the monitor drum, the operator has an oscilloscope which monitors the signals as they are being recorded and/or during playback after recording.

At the end of each day's work, the completed "raw" field tapes are sent with data sheets to the laboratory, or local field office, for processing and integration.

CENTRAL-OFFICE PROCESSING: Experience has proved that the intricate processing and record-integrating procedures should be done under laboratory conditions, with trained specialists operating the central-office processing machines under the supervision of a geophysicist.

The geometrical discrepancies, in travel paths, of energy from the various subsurface layers, known as "stepout," or "normal moveout," must be removed by this processing equipment to assure proper line-up of vertical energies for accurate integration. Since stepout corrections vary throughout the record with each vertical reflection, a dynamic correction must be applied according to the velocities of the record area. Electronic computers, incorporated in the office analyzer (Fig. 8) accurately apply the stepout corrections necessary. This correction is accomplished in two ways. A preshaped cam and/or an electronically controlled function generator may be used to program a servo mechanism in dynamically moving a playback head dur-

(Continued on page 80)

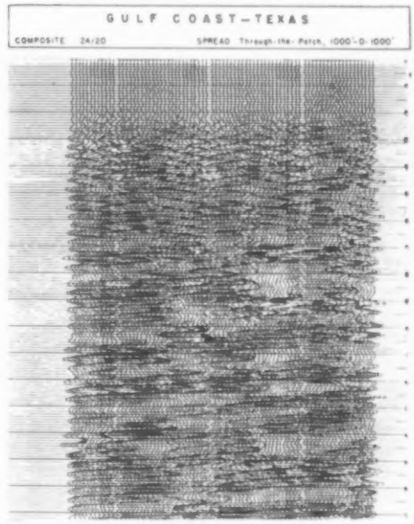


Fig. 11 24/20 composite Gulf Coast-Texas record section.

Fig. 9 80/76 composite West Texas record section.

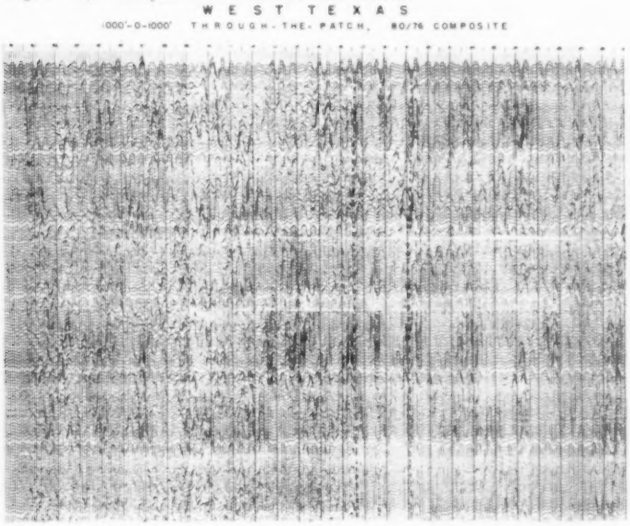
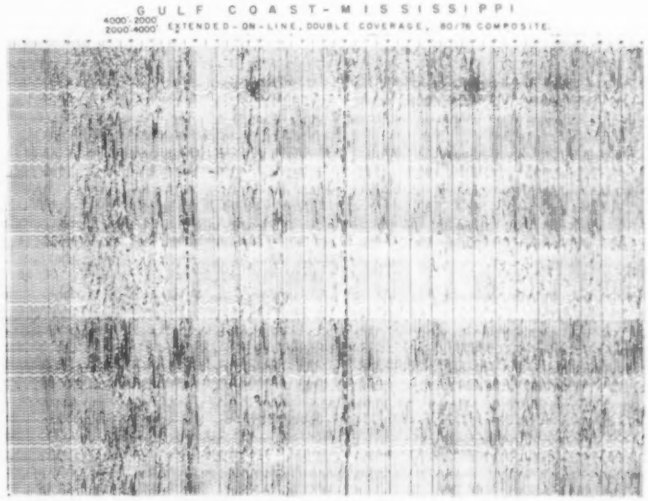


Fig. 12 80/76 composite Gulf Coast-Mississippi record section.



MARINE

SEVERAL years ago the Magnolia Petroleum Co. field research laboratory undertook a study of the modern sediments and the processes by which they form, in an effort to achieve a better understanding of the ancient sediments. Early in this study it became apparent that adequate stratigraphic information could not be obtained from bottom sediment samples alone. The Marine Sonoprobe was developed initially to supply additional information for this study project.

Basically, the Marine Sonoprobe system functions like a small reflecting seismograph. Sound pulses, having a dominant frequency of approximately 4,000 cycles per second, are generated at the rate of approximately 12 per second. (This frequency is much lower than the 13,000 cycles used in echo sounders.) The sound waves are propagated through the water into the sediments, and are reflected back by interfaces between sedimentary beds when a sufficient contrast in acoustic impedance exists between the beds. The reflected energy is converted by the receiver into electrical signals which are recorded on continuously moving electro-sensitive paper. The end result is a profile of the sea floor, together

* Trademark of Magnolia Petroleum Co.

Fig. 1. The Marine Sonoprobe receiving transducer mounted as an outrigger aboard the M.V. "Falcon": The transducer is swung down and fastened to the hull of the boat when a survey is being conducted.

SONOPROBE* *A New Seismic System for the Study of Recent Sediments*

with the stratigraphic and structural relations of the beds of sediments immediately beneath the sea floor.

Reflections have been obtained from interfaces 175 ft to 200 ft below the sea floor in certain areas, although penetration of this magnitude is exceptional. In general, the depth of penetration is a function of the acoustical properties of the sediments in a subject area. It is necessary that the sediments have a minimum contrast of 5% to 10% in acoustic impedance between beds for reflection of energy to occur.

All of the factors which produce differences in acoustic impedance of sediments are not known at the present time, but it is known that differences in the lithology do have a pronounced effect on acoustic properties.

The Marine Sonoprobe has been operated in the Gulf of Mexico, off the California coast, and in Venezuela, and has been operated in waters more than 1,000 ft deep with very satisfactory results. Good records are obtained with a boat speed of 4 to 6 knots in most installations, and acceptable records have been obtained at 10 knots in one exceptional installation.

The Marine Sonoprobe can be installed in virtually any type vessel which may be available in a given area, since the com-

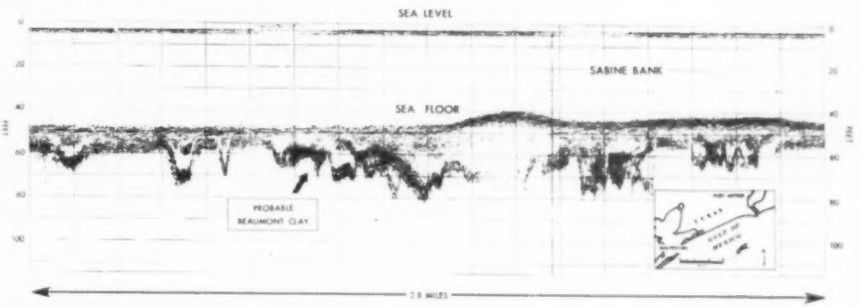
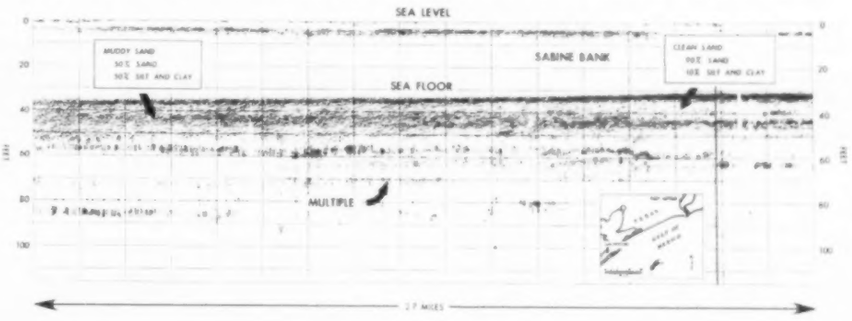


Fig. 2. Ancient river channels buried beneath recent sediments in the Gulf of Mexico.

Fig. 3. Facies change of sand into mud on the landward side of Sabine bank in the Gulf of Mexico.



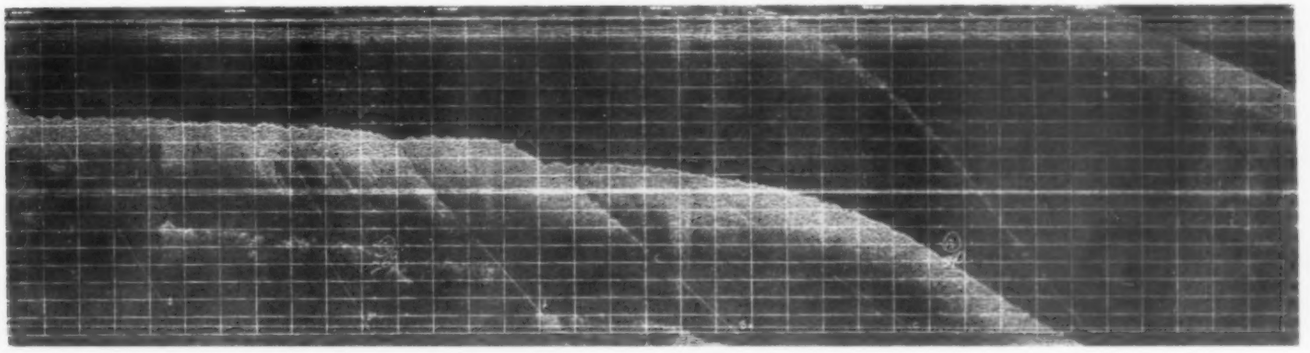


Fig. 4. Example of records obtained in Pacific waters.

plete system weighs less than 800 lb. An outboard installation will be available shortly for use in small specialized surveys, or larger surveys in remote areas of the world.

Experience has indicated that the Marine Sonoprobe can provide, very economically, valuable information about the sediments beneath a body of water. It has numerous potential uses in the fields of engineering, geophysics, and geology. Information which is necessary for the construction of submarine pipelines, offshore platforms, and other marine installations can be obtained readily with Marine Sonoprobe surveys. The extent of silting in reservoirs may also be determined. The geophysical and geological applications are obvious.

Surveys with the Marine Sonoprobe system off the coasts of Texas and California have recorded many different geologic phonomena. Examples of these records are discussed hereinafter.

Fig. 3 is a Marine Sonoprobe record of a traverse across a truncated anticline in the Gulf of Mexico near Galveston, Texas. There is no topographic expression on the sea floor above the anticline. Data obtained from coring, at the point indicated, shows the Beaumont clay (Pleistocene) overlain by 1.5 ft of recent mud—thus establishing that the reflections are from interfaces in the Beaumont clay. The dip of the beds on the flank of the structure is approximately ½ deg.

A fault with a vertical displacement of 5 ft is shown in Fig. 4. This fault is on the flank of a known structure.

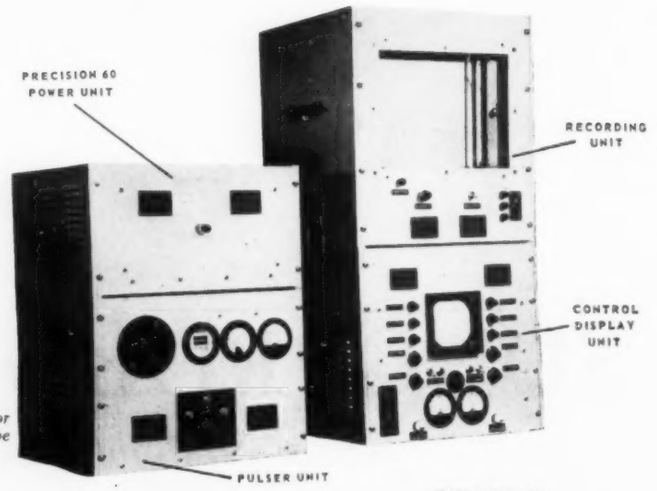
Fig. 5 shows some ancient river channels buried beneath recent sediments. The topographic feature is part of the Sabine bank in the Gulf of Mexico.

An example of a facies change of the recent sediments on the Sabine bank is shown in Fig. 6. The clean sands are composed of material of which 90% is greater than 0.062 mm in diameter ("sand"), and 10% is smaller than 0.062 mm in diameter ("silt" and "clay"). The clean sand is laterally equivalent to muddy sand which is composed of material of which 50% is greater than 0.062 mm in diameter, and 50% is smaller than 0.062 mm in diameter. The first reflection beneath the sea floor is the interface between the clean sand and the underlying mud.

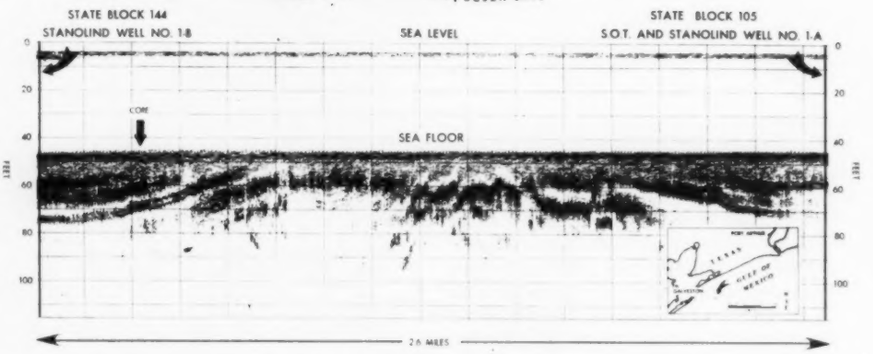
A profile obtained in Corpus Christi Bay is shown in Fig. 7. The prominent buried mounds are oyster reefs, or banks of oyster shells and sand, beneath recent sediments. Several reflecting horizons which correlate with changes in lithology are present. Stratigraphic pinchouts of beds against the reefs are evident.

Fig. 8 is an example of records obtained in Pacific waters. The recorded dip angles are exaggerated due to different vertical and horizontal scales, but simplicity of interpretation is obvious.

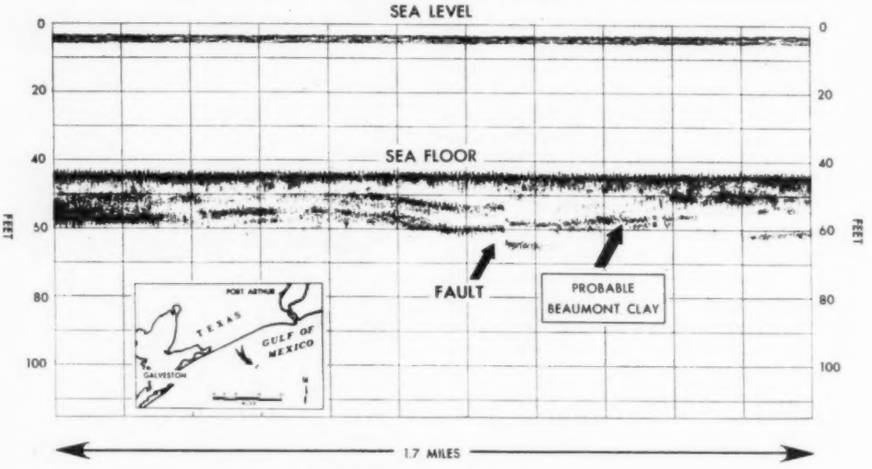
Marine Sonoprobe surveys are being offered commercially throughout the world by Fairchild Aerial Surveys Inc., 224 East 11 St., Los Angeles 15, Calif. END



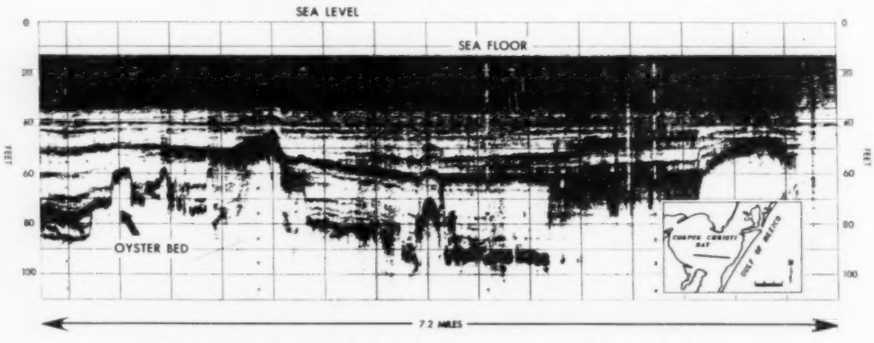
Panel units for Marine Sonoprobe instrumentation.



Truncated anticline in the Gulf of Mexico near Galveston, Texas.

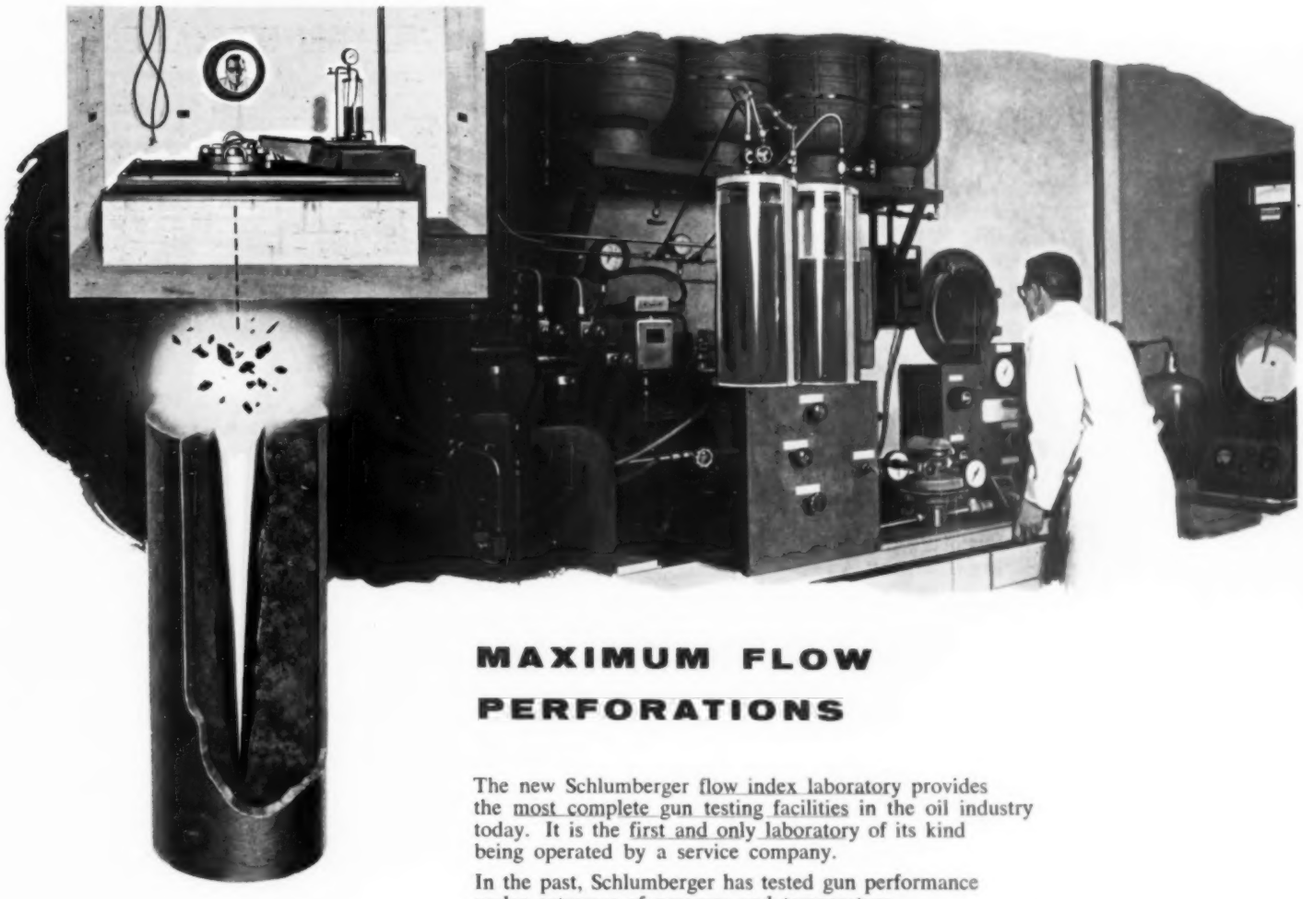


Normal fault in the Gulf of Mexico.



Ouster reefs buried beneath Recent sediments in Corpus Christi Bay, Texas.

New from Schlumberger ---



MAXIMUM FLOW PERFORATIONS

The new Schlumberger flow index laboratory provides the most complete gun testing facilities in the oil industry today. It is the first and only laboratory of its kind being operated by a service company.

In the past, Schlumberger has tested gun performance under extremes of pressure and temperature. Now, it is also possible to fire guns under formation-to-hole pressure differentials identical to those existing underground.

As fluid is forced through the perforations, a definite flow index is accurately established for different types of perforations and formations.

When you call Schlumberger, you can be sure that the perforator used on your well has been pre-tested under field conditions to give perforations with a maximum flow rate.

SCHLUMBERGER

Well Surveying Corporation

THE EYES OF THE OIL INDUSTRY

Schlumberger...to be sure!

Serving petroleum refiners around the world

HOUDRIFLOW • HOUDRESID • HOUDRIFORMING • HOUDRY ISO-PLUS • HOUDRY DEHYDROGENATION

The Ohio Oil Co.
Lion Oil Company
The Pure Oil Company
Clark Oil & Refining Corporation
Salt Lake Refining Co.
The California Oil Company
Texas Butadiene & Chemical Corporation
Standard Oil Company of Texas
Texas City Refining, Inc.
Gewerkschaft Erdoel-Raffinerie Emsland
The Shamrock Oil and Gas Corporation
Daikyo Oil Co., Ltd.
Canadian Petrofina Limited
Commonwealth Oil Refining Company, Inc.
Sun Oil Company
Crown Central Petroleum Corporation
Ashland Oil & Refining Company
Western States Refining Company
Albatros S.A. Belge pour le Raffinage de Petrole
Minerals & Chemicals Corporation of America
Leonard Refineries, Inc.
Richfield Oil Corporation
Sinclair Refining Company
Standard Oil Company (Ohio)
Sun Oil Company, Ltd.
Union Oil Company of California
U. S. Oil & Refining Co.
X-L Refineries Limited
Tidewater Oil Company
ANTAR-Petroles de l'Atlantique
Continental Oil Company
Standard Oil Co. of California
Chemische Werke Huels Aktiengesellschaft
SAROM (Societa Azionaria Raffinazione Olii Minerali)
The Firestone Tire & Rubber Company
Socony Mobil Oil Company, Inc.
Petro-Tex Chemical Corporation
Odessa Butadiene Company
Gulf Oil Corporation
Sioux Oil Co.

HOUDRY PROCESS CORPORATION offers a complete service that includes process-licensing, engineering design, technical services on catalytic processes, for the petroleum refining and chemical industries. Special research and development services are available under contract.

Five proved processes are offered to petroleum refiners around the world:

HOUDRIFLOW Catalytic Cracking Process for the highest product yields at lowest costs

HOUDRESID Catalytic Process for cracking the bottom of the petroleum barrel

HOUDRIFORMING Catalytic Reforming Process for maximum yields of aromatics or highest octane fuels

HOUDRY ISO-PLUS Catalytic Reforming Process for reforming low-octane naphthas into 100-octane gasoline

HOUDRY DEHYDROGENATION Process for the production of butadiene, other diolefins and monoolefins.

HOUDRY CATALYSTS are included in a general line of pelleted catalysts manufactured and marketed for Houdry Processes and for general application in the petroleum, chemical and pharmaceutical industries.

HOUDRY
PROCESS CORPORATION
Pioneer in Catalytic Processes

For information on Houdry processes and services, write to Houdry Process Corporation, 1528 Walnut St., Philadelphia 2, Pa.

Vance M. Lynch joined Tidelands Exploration Co. immediately following his graduation from the University of Texas in 1951. He began as a helper and by 1954 had been advanced to party chief. After a period in the central offices doing special analytical and interpretative work he was made gravity director of the company in January 1956.

The largest continuous offshore gravity program thus far undertaken by the industry is now in progress. At present the entire area from Sabine Pass, Texas, to New Orleans, La., is being studied.

FIELD TECHNIQUES AND PROBLEMS IN OFFSHORE GRAVITY PROGRAM†

*by Vance M. Lynch**

BECAUSE of the ever-increasing demand for petroleum, geologists and geophysicists are attempting to expand the frontiers of existing information. An outstanding example of such a frontier is the offshore area adjacent to the Texas and Louisiana Gulf Coast. At the present time the entire area between Sabine Pass, Texas, and New Orleans, La., is being surveyed by offshore gravitational methods as a tool for isolating structural conditions favorable for the accumulation of petroleum. These structural or anomalous areas then can be checked further by the seismograph and other geophysical and geological methods prior to drilling. More and more exploration men are becoming convinced that the percentage of completions is definitely higher when all possible independent lines of evidence are utilized. At present this work is being carried from a definite network of land bases along the coast out to a water depth of 120 ft. However, definite plans have been made to extend the work off the entire Louisiana coast out to a water depth of 250 ft, and there is a definite possibility that this program will be extended out to the margin of the continental shelf.

METHODS UTILIZED: The gravity observations are being made by utilizing electronic surveying, remote-controlled underwater meters, and remote-controlled pressure gauges. The operating personnel consists of a party manager, a meter operator, a hoist operator, two deck hands, a cook, a boat captain, an engineer, and an electronic surveyor.

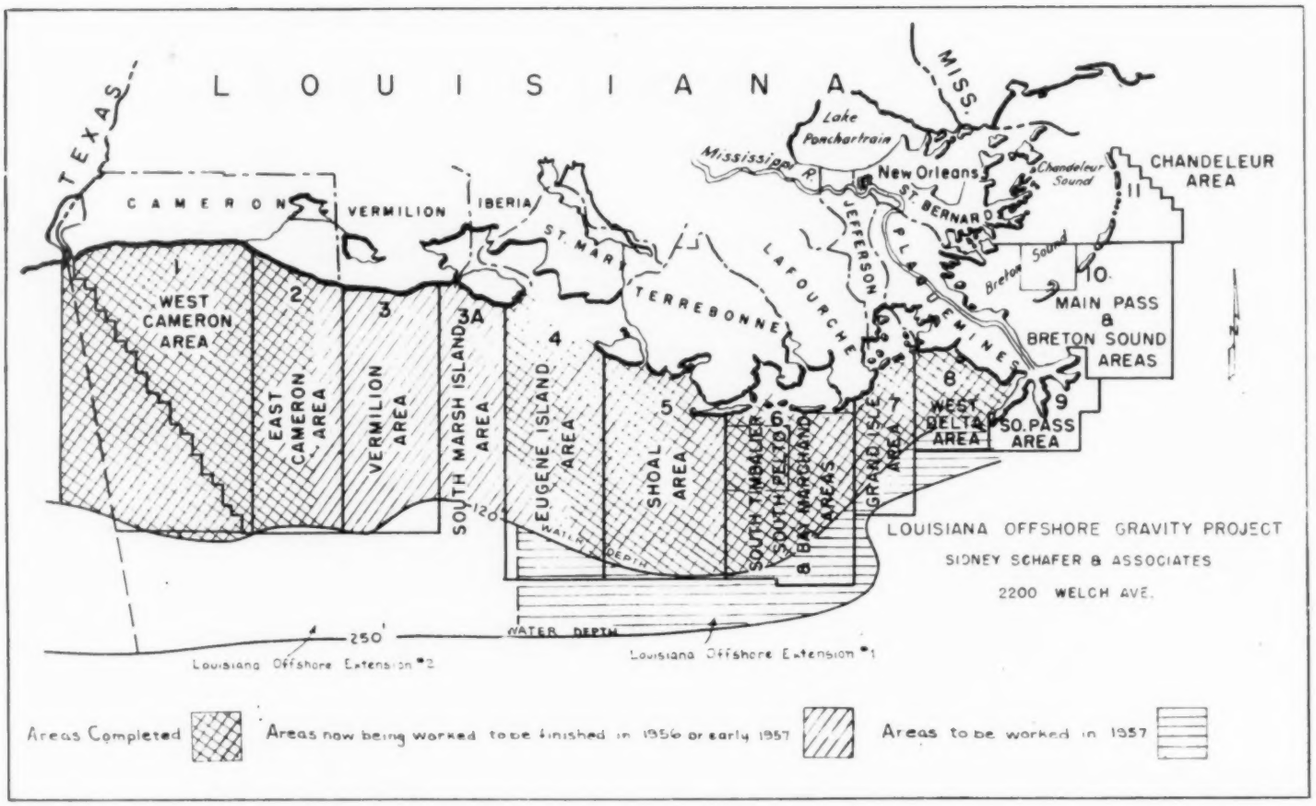
CONTROL AND TOLERANCES: For the particular survey discussed in this report, the area is divided into one-mile blocks, and an observation is being made for the center and corners of each block. The bases are being located in a network of blocks approximately 5 to 10 miles in dimension. The accuracy maintained is 0.25 milligals for the stations and 0.20 milligals for the base stations.

PROBLEMS INVOLVED—POSITION: There are any number of problems involved in such a program. In gravity work, a network of extremely accurate locations—known as base stations—must be established throughout the area to be worked. The location of these points must be accurate to within 100 ft if the desirable accuracy in data is to be maintained. This not only means that the point has to be located this accurately, but it must be reoccupied several times within the same limit of accuracy. It is obvious that these points must be located by electronic methods, and even these methods often fall short of the desired accuracy. One important aspect of the positioning problem is that of maintaining the proper relative positions between the antenna and the meter on the bottom while the location fix is being obtained. Such factors as wind velocity, direction and magnitude of wave action, water depth, and crew efficiency all enter into this problem. It might also be pointed out that, in an extensive survey of this type, it is very difficult to maintain the proper relative positions because of the crossing of network boundaries and slight accumulated calibration errors.

TRANSPORTATION: The type and condition of the boats used is also very important in offshore work. Probably the best boat for gravity work in the Gulf is the converted crash boat. Although somewhat slower than some of the other types, this boat is wide-beamed, and has a minimum amount of

* *Director of Gravity Meter Exploration, Tidelands Exploration Co.*

† *Survey being conducted in the Gulf of Mexico by Tidelands Exploration Co. under contract to Sidney Schafer and Associates.*



motion perpendicular to the long axis of the boat. This condition makes it possible to make observations in 10-ft to 12-ft seas.

GRAVITY METER: There are two types of underwater gravity meters in common use. So far as accuracy is concerned, either one of these meters is quite acceptable. Both types of instruments have certain desirable and undesirable qualities. There are a number of factors, such as water depth, bottom conditions, and operating personnel, which should be considered in deciding which meter should be used.

OPERATING PERSONNEL: Probably the most important problem in offshore gravity work is getting the proper personnel. The entire crew must work as a unit, and each position must be adequately filled. Of course, the most important position is that of the party manager, since he must be able to supervise the electronic surveying, boat handling, and gravimetric surveying. He must also have a working knowledge of all equipment utilized in order to make routine repairs on board the boat.

OPERATION: In a routine operating day, the boat first goes to a calibration point, which usually consists of a piling near the entrance to protected water, and sets the electronic positioning instruments at the proper readings for this known point. The crew then proceeds to an established base position, which may be as much as 100 miles offshore. When the boat reaches the base position, the surveyor orients the boat so that, in the process of stopping the boat and lowering the meter, the instrument will be on position when it reaches the bottom.

After the meter reaches the bottom, the position is recorded and the meter operator levels the meter by remote control, then nulls the meter and records the gravity reading, the depth, and the time. After these recordings are made, the meter is hoisted to the deck, and the boat proceeds to a new base location approximately five miles away where another reading is taken. Then the boat returns to the initial base and takes a reading, and then returns to the new base for a second reading on it. These four readings constitute a normal base run and require approximately one hour and a half for completion.

These procedures are repeated around a loop, and are tied to another known base. It is very important that all base readings be accurately taken, since the entire loop must close within 0.20 milligals. After the loop is completed, the crew then proceeds to observe the stations inside the loop. In order to observe intermediate stations, the operator must initiate the station observations by reading a base and complete the line at a base. The difference in base readings, after corrections are made, must be within 0.25 milligals of the known difference between the two base values. In a normal operating day, approximately 40 stations are observed. Of course, these normal days are offset by days when the water is too rough to work or when equipment fails. Worse than this, there are minor catastrophies which occur from time to time. Among these are such things as the complete removal of radio and electronic antennas by sudden squalls, and the breaking of hoisting cables to leave extremely valuable instruments on the ocean floor which can be recovered only by professional divers. These incidents often cause several days' delay in the work.

RESULTS: For obvious reasons, no specific results of the completed offshore program can be divulged. However, it might be pointed out that, as in most salt-dome provinces, the correlation with known structure has been highly favorable and that numerous outstanding new prospects have been revealed. This work not only is being used as a guide for future exploration work, but also to confirm existing information. There are very few data published regarding offshore findings. However, Markley,[1] in his paper on Humble's Block 18 field, gives a good illustration of the excellent correlation which can be achieved between gravity data and structural features in this offshore province. As more data are published, the value of gravity data in this area will be more evident to all concerned.

END

ACKNOWLEDGMENTS

The author wishes to thank Messrs. J. B. Ferguson, R. J. St. Germain, and E. E. Jones of Tidelands Exploration Co., and Jack Weyand of Sidney Schafer and Associates for their advice and assistance in the preparation of this paper.

[1] *Leo Markley, "Geophysical History of Grand Isle, Block 18, Oil Field, Gulf of Mexico, Louisiana,"* Geophysical Case Histories, *Vol. 2, 1956.*

NEW TOOLS FOR THE GEOPHYSICIST

Laboratories of the oil companies and seismic instrument manufacturers continue to perfect earlier equipment and to develop new techniques and tools to aid in the search for oil.

RAPID advances were made in 1956 in the application of electronics to the gathering, storage, and interpretation of geophysical data. Central-office equipment for the presentation of seismic data in a form which will permit the interpreter to visualize subsurface conditions more readily has been perfected by a number of instrument manufacturers. Analogue and digital computers have been pressed into service to aid the geophysicist. An entirely new seismic method has been developed as an aid in offshore exploration.

A spectacular expansion has taken place in magnetic recording of seismic information. Increase in magnetic units in the field in 1956 was about 160%. By the end of 1957 use of magnetic recording is expected to be almost universal.

Concurrent with the growth in magnetic recording on tape or discs has been the development of playback, filtering, and compositing equipment. Portable units for use in the field have been supplemented by elaborate central-office installations involving automatic velocity computation and corrections to the datum plane and for weathering and stepout. Correction factors are punch-carded in some systems for automatic feed to the mechanism. Other programming methods are employed in digital-computer units where it is desired to provide both constant and time-variable delays between seismic traces.

At the recent New Orleans meeting of the Society of Exploration Geophysicists much interest was shown in the cross-section method of presenting data to which a number of approaches were shown by seismic equipment manufacturers. All of the methods involve the playback of magnetic recordings one trace at a time. The traces are corrected and reproduced by various means to simulate geological cross-sections. Some may finally appear as closely-spaced traces similar to those on the original seismic record. Others may be displayed as dots using electrically sensitive paper, while others may use photographic techniques employing variable-light density.

Gravity records have not been overlooked in the drive to aid in interpretative work. One such device is the SSC optical analogue gravity computer. HTL has perfected a gravity anomaly simulator which permits the accomplishment in a few hours of computations which would require days by normal calculating methods.

Photography is coming out of the dark room in the field of geophysics. One new photographic process, "Kalfox," uses heat alone for film development without chemicals, vapor, or a wet agent. A 5-ft film negative is exposed and developed, without the use of a dark room, in one minute.

Work is in process for the field recording of seismic data by nonphotographic means. The "Electrofax" process of Radio Corp. of America employs an electrically-charged paper on which an image is fixed by heat. The Western Union "Teledeltos" paper is another approach. In this method a stylus removes a white layer from record paper by electrical means, leaving a dark image below.

Improvements in detectors have been made by instrument manufacturers. One such is a sturdy unit which can be speedily reeled in and out without sacrificing sensitivity because of rough handling. Purpose is to speed up field work. In offshore work, pressure-sensitive detectors with preamplifiers have been found effective in shallow water as well as in marshy areas. Such detectors have been used previously in deep water, but not in shallow areas. Use of fewer phones per trace aids in expediting field work, and improves results.

A new geophysical tool for offshore work announced recently by Magnolia Petroleum Co. is the "Marine Sonoprobe" which is described elsewhere in this issue. This new instrument aids in rapid surveys of layering in the first few hundred feet below the ocean bottom. This is a fathometer-type instrument employing a magnetorestrictive source and a ceramic crystal pickup. The recorder gives a continuous profile, directly depicting structure of Recent sediments.

Weight-dropping techniques on both land and water have been improved during the past year, as is indicated in a special article elsewhere in this issue.

Refraction techniques have been employed more frequently during the past year as a primary reconnaissance method in unexplored areas and for the delineation of salt domes.

Regional studies are being greatly aided by the expansion of velocity logging and by the development of new methods of making subsurface measurements in bore holes. One such is the Dumont multiplier phototube. This tube, which is only ¾ in. in diameter, is capable of multiplying a signal several hundred thousand times. It may be used for spectrometry as well as scintillation counter work. With such tubes, it is possible to measure gamma-ray spectra and thus select only that radiation which is characteristic of a particular element or group of elements. Chemical composition of deep layers can be ascertained. Small-size accelerators have been developed for more efficient neutron logging.

The science of geophysics as applied to the finding of oil is very young in point of time. The reflection seismograph first demonstrated its ability to find oil only 30 years ago. Fortunately for a world which is hungry for oil, the geophysical-instrument manufacturing industry is as vigorous and imaginative as it is young. Aided by research at the universities and in the oil-company laboratories, as well as in its own plants, the industry is developing new and better equipment for measuring and recording data at an explosive rate. In the following pages will be found reports on some of this new equipment, prepared especially for *World Petroleum*. END

NEW TOOLS FOR THE GEOPHYSICIST

CENTRAL OFFICE PROCESSING OF OFFICE DATA

Hal J. Jones received undergraduate training in geology and mathematics at DePauw University and at Louisiana State, where he received a B.S. degree in 1945. During 1945-46 and 1948 he pursued graduate studies in geophysics at the California Institute of Technology. He received an M.S. in geology at the University of Cincinnati in 1947, and the Ph.D. degree in geology at the University of Texas in 1950. During 1947-48 and 1950 he worked as a geologist and geophysicist for Shell Oil Co. In 1951 he served as a physicist and research group head for Engineering Research Associates, working in Utah on underground explosion studies connected with bomb-shelter design. During 1952 he was employed by Stanolind Oil and Gas Co. as technical supervisor of a field research crew. In December 1952 he joined Texas Instruments Inc., Dallas, Texas, and later became director of geophysical research. In 1956 he became chief engineer at the industrial instrumentation division at Houston, Texas. His memberships include SEG and IRE.

By Hal J. Jones*

A SEISMIC exploration crew can become an efficient, economical data-collection operation by advantageously utilizing modern magnetic recording equipment. Rather than being a complete preliminary data-interpretation unit operating under most unfavorable conditions, the exploration party becomes a more effective link in the chain of modern seismic exploration. The operation of analysis and interpretation, requiring for their success highly trained technical and scientific personnel, may be located in a central office. This will ease many of the morale and personnel turnover problems common in the seismic exploration industry today.

There are other obvious economic and technical advantages associated with the central data-processing concept. Since the processing equipment in one location serves many field crews, it is possible to afford much more complex and expensive analysis equipment. Furthermore, the data may be processed much more rapidly. This is particularly advantageous in keeping up with large-volume applications such as marine seismic prospecting.

One of the most important advantages of this approach to seismic data processing concerns increased flexibility. The data may be replayed through the analysis equipment many times, changing various parameters until an optimum combination has been reached.

The most frequent objection to central processing of seismic data involves the possible breakdown or weakening in the close contact between field and office. This can be alleviated by using monitor records for the preliminary analysis essential for proper execution of the field program.

Briefly, this is how the system would work in practice. Field crew recording equipment would consist, of course, of transducers, the necessary magnetic recording amplifiers, and the magnetic storage itself. It would also be necessary to provide a means of monitoring to insure that the various parameters of field operations such as hole depth, detector placement, etc., are proper. In very routine operations it might

* Chief engineer, Industrial Instrumentation Division, Texas Instruments Inc., Houston, Texas.

Fig. 1 SeisMAC magnetic automatic computer, with two magneDISC transducer units for playback and restorage of corrected seismic records.

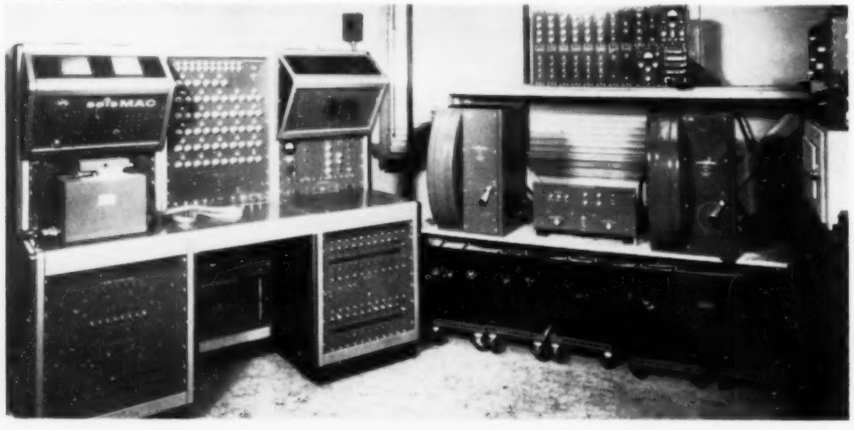
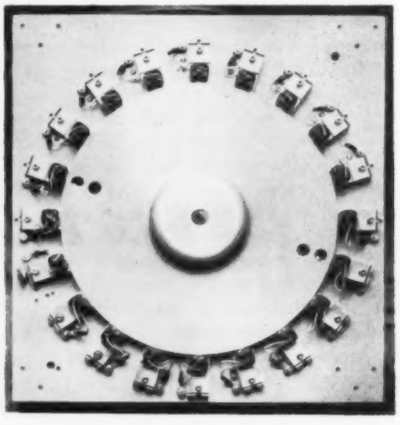


Fig. 2 SeisMAC 10-millisecond delay-drum unit.



NEW TOOLS FOR THE GEOPHYSICIST

be possible to place enough confidence in the magnetic recording equipment so that its operation may be monitored through simple metering operations. Thus field playbacks would be the exception rather than the rule.

The magnetic record from the field would then be sent in to the central playback and interpretation office. The equipment situated here would consist of (1) magnetic playback apparatus, including a record transport and the necessary associated electronics; (2) means of carrying out routine time corrections and computations on magnetically recorded seismic data; and (3) means for preparing time-corrected depth records and/or sections. Processed records and sections would then be sent to skilled interpretation groups.

Although difficult communication lines would appear to make the central-office system unattractive in many single or few crew operations in inaccessible locations, modern air transportation makes central processing feasible. Use of field magnetic recording apparatus compatible with a central playback facility will increase the effectiveness both of the field crew as a data-collection unit and of the interpretation and analysis effort.

Standard methods of seismic data processing involve visual detection of event arrival times on the original records and subsequent corrections and computations based on these event times. These operations lead, after considerable tedious computational labor, to two-dimensional subsurface cross-sections plotted in terms of surface distance versus time or depth. These often form the chief basis for subsurface interpretation.[3]

The sections present the information from a number of records in a single chunk.

The same end can be achieved if the entire original trace can be properly corrected and placed in its proper relative position on a time section, thereby eliminating tedious computation and plotting. This has been accomplished in part for a number of years by means of composite record sections prepared photographically.

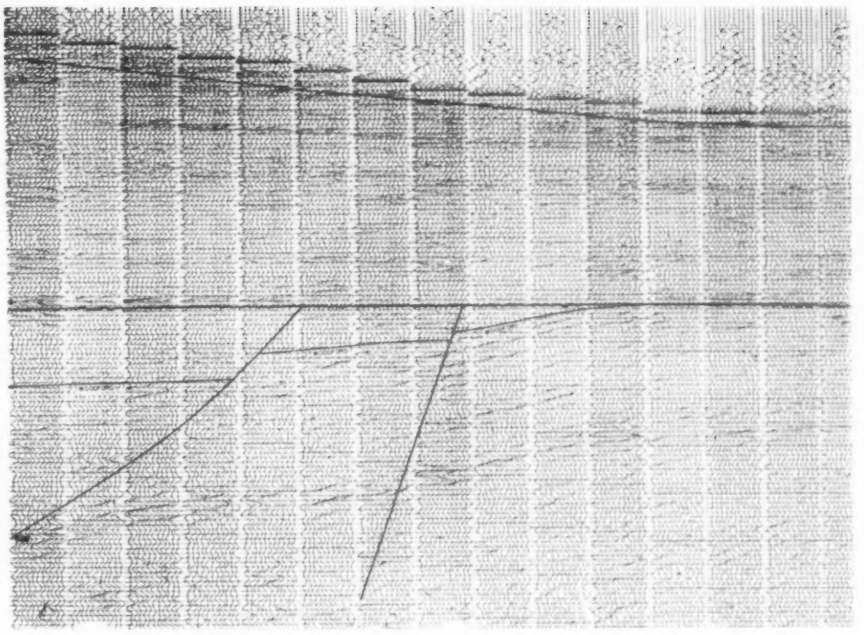


Fig. 4 Typical prepared record cross-section, using seisMAC and magneDISC equipment.

Use of these record sections, however, was affected adversely by inability to adjust individual traces for time differences due, for example, to weathering and elevation differences and to normal moveout.

Since the interpretation of seismic data depends upon visual detection of the events and patterns of events, whether on the original records or on the record sections, the utility of time corrections before the records are picked and before the cross-section itself is made becomes clear. Ability to change the relative positions of a set of magnetic record-reproduce heads provides partial means for making such corrections.

In the conventional method of seismic data processing, raw data in the form of analogue curves are digitized to event times and collected in tabular form along with associated parameters such as shotpoint and receiver coordinates, shotpoint-to-receiver distance, elevation, etc. A number of corrections must be applied to the raw times, i.e., reduction to a datum plane, weathering corrections, normal moveout corrections, time-break and filter corrections.

The correction procedure requires computations and/or table or chart lookup procedures, and in many cases is one of the most time-consuming parts of seismic data processing. The corrected data must be plotted in cross-section form, often after a computation converting vertical time to depth. Finally, in most areas, a number of steep dipping lineups must be migrated into their proper x-z positions. Although the computers may be helped in carrying out the above chores by numerous aids such as desk calculators, tables, slide rules, plotting arms, etc., the work goes slowly, is subject to numerous errors, and does not stimulate the budding geophysicist's creative powers.

The above difficulties can be alleviated by employing a data processing procedure

Fig. 3 Equipment for preparing dynamic correction tape for programming of seisMAC.

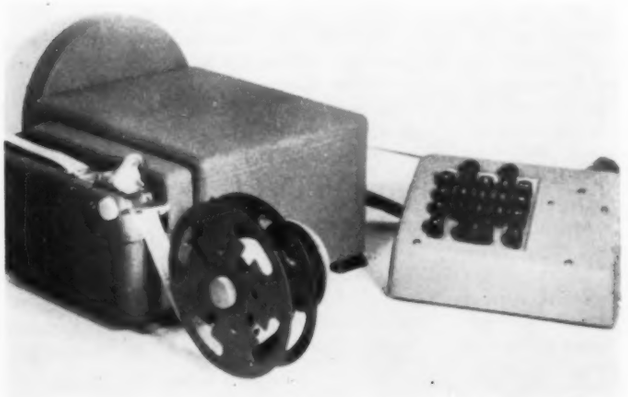


Fig. 5 Auxiliary central-offi equipment for use with seisMAC, including all-purpose seismic amplifier system and Texas Instruments time-depth camera on the right.

which is a direct mechanical analogue of the conventional method, in that the same steps are followed in about the same order but in which digital data-handling equipment is used to perform the "busy" work. This method employs semi-automatic oscillogram readers to digitize picked records, digital computers to perform time corrections, T-Z, and migration computations, and automatic plotters to prepare cross-sections. High equipment costs have limited use of this method to large-volume applications such as marine work or to central-office processing in review work.

Equipment which permits an operation on the played-back seismic signals (originally magnetically recorded) in their analogue form to obtain a correctly processed record section may be designated as *analogue* data-processing systems. This is in contrast to digital systems which convert the data to sets of numbers and operate on these numbers by simple arithmetic steps.

Proposals for analogue systems for seismic data analysis have been presented many times in the relatively short history of geophysical exploration. More recently, an analogue system utilizing optical and mechanical apparatus has been applied to seismic data processing.

Now systems working directly from the magnetic records to corrected cross-sections, and also first preparing corrected magnetic records, are becoming commercially available. These systems have the advantage of providing time-corrected data in reproducible form for subsequent mixing and shot compositing.

In the conventional and digital computer methods outlined above, the data are reduced, in other works picked, before a section is prepared—although, of course, a considerable amount of reduction and revision may go on as the section is studied. In the reduction procedure, records are normally studied in groups, in other words, in composite record sections.

Using the analogue apparatus, all or at least most of the data are transferred to the section, and reduction is done on the section itself. Some apparatus may compromise slightly, in that only limited amounts of the total wave-form may be preserved. Presumably, this partial reduction of total information content makes visual detection of signals easier. In any event, the utility of corrected record sections in interpretation is beyond question.

An analogue seismic data-processing system, the seisMAC, has been developed by the Industrial Instrumentation Division, of Texas Instruments Inc., for the reduction of seismic data. The apparatus is illustrated in Fig. 1. Design objectives stressed flexibility, compatibility with a wide variety of magnetic recording equipment, minimum wave-form distortion whenever desired, and the ability to prepare a corrected reproducible record for subsequent trace mixing and shot compositing. By replay and mixing of the corrected data, one may store the original data of many records on a single magnetic record.

The system is essentially a programmed time-delay unit, the time delay being accomplished by the magnetic delay drums shown in Fig. 2. These drums utilize high surface speeds and noncontact FM magnetic recording techniques. Constant delay of any trace is readily achieved by connecting to a given pickup head on each of the two drums shown.

The two-drum system is used to provide fine delay increments by using a very high-speed drum, and a large delay range by utilizing a somewhat slower-speed drum—with a consequent minimum amount of engineering difficulties. The total delay introduced in any trace is the sum of the delay introduced on the two individual drums.

The unit processes a multi-trace magnetic record one trace at a time, feeding each trace individually through the apparatus in an automatic, sequential fashion.

To correct the multi-trace record for any set of constant time corrections, the operator sets the computed corrections up on a battery of rotary switches on the equipment's front panel and then simply presses the start button. The entire record is then processed automatically and either restored on the magnetic medium for future analysis or read directly out onto a conventional or a section camera.

To obtain time-varying corrections, one must change the time delay during playback of the record as an arbitrary function of time. Time variable corrections are desirable, for example, for normal moveout removal, and to line up events with a considerable stepout in different parts of the record as a prelude to mixing in an effort to enhance the visual definition of sets of events with particular dips. Time-varying corrections can be accomplished by switching among the pickup heads, shown on the magnetic drums in Fig. 2, according to a predetermined pattern.

This means that time-varying correction functions such as are required for normal moveout and which can also be used to effect time-to-depth coordinate conversions can be simulated by discrete steps of delay change. It also means that, since the time and amount of delay change can be programmed very flexibly, the delay program can be planned to place the delay changes in noisy sections of the record and to delay chunks of the record with no distortion introduced by the delay-change procedure. This may be particularly valuable in early portions of the record, since here the normal moveout is changing rapidly, and the use of a moving pickup head corrector gives rise to severe stretching and distortion of the waveform. In contrast, the seisMAC system can be programmed to shift entire sections of interest in this early portion of the record without any delay change occurring during the actual event itself. This can be readily done after a brief study of sample seismograms from the area.

The programming is handled in a very simple and flexible fashion by digital programming techniques. The delay programs are first worked out by computational procedures, and are then prepared on punched-paper tape in a binary coded form, using an easily operated decimal keyboard-converter and a motorized tape punch shown in Fig. 3. During the processing of the record, a photoelectric tape reader scans this punched-paper tape and introduces the desired program into an internal memory within the seisMAC.

This internal memory is comprised of magnetic core-shift registers. Introducing the delay pattern into the record as it is being processed now consists simply of unloading the memory as the record is played back. The delay-change information contained in the memory is synchronized by computer clock circuits, and actuates electronic gate circuits which connect the proper delay heads at the proper time. Switching transients are eliminated in normal seismic problems.

The system also provides filtering and additional volume control, if desired, on a single-channel basis. Since only a single channel is used, some rather complex filtering devices are practical. For example, the filtering element could consist of a magnetic-drum time-domain filter.[2]

In addition, use of the digital programming methods promises other future applications for the system. By way of example, the delay drums could be used as variable-delay elements in the correlation function computation[1] which would require, of course, the addition of analogue multipliers and integrators.

Operation of the system is quite simple. The weathering and elevation corrections for multi-trace records are preset into the system, as outlined above, for all traces before the processing begins. For example, for a 24-trace record, 28 sets of controls are provided—24 for the seismic data and 4 for auxiliary data—thus providing means of delaying time break, shotpoint seismometer, etc. Each set of controls consists of switches providing coarse time-delay control; in other words, selecting heads on the slow drum, and fine time-delay control, which selects heads on the fast drum, and add or subtract select switches so that positive and negative delay conventions may be introduced.

Constant time corrections may be made over a 100-millisecond range in 1-millisecond increments, and 100 milliseconds are available separately for variable time corrections. Special equipment modifications permit the use of larger delay ranges. The time-delay amounts for the switching times in the variable time-delay program are predetermined by calculating the amount of

(Continued on page 80)

NEW TOOLS FOR THE GEOPHYSICIST

SSC SEISMIC REPLAY CENTER

THE SSC seismic replay center consists of 3 principal units: 1, a replay console; 2, a visual-display unit; and, 3, a cross-section camera. Magnetic-field recording tapes processed by this center are corrected for weathering, elevation, and normal stepout. The corrected signals then may be composited and filtered so as to achieve the most favorable reflection-to-noise ratio. This operation also permits the reflection signals to be displayed in the most useful manner. For instance, the signal traces, after compositing and filtering, can be observed on a 21-in. video tube, which is a part of the visual-display unit. Once the optimum results have been observed here, the signal's traces may then be recorded by a conventional camera as variable-amplitude traces; or they may be rerecorded for storage, or presented as a variable-density cross-section using the cross-section camera. This special camera has the capacity to handle 24-in. photographic paper on which 128 variable-amplitude or 400 variable-density traces may be displayed—all to a common datum plane. A description of the principal units follows:

The IMK seismic replay console is designed for the complete analysis of seismic data reproduced from magnetic-tape field recordings.

The console includes provisions for performing the following operations: magnetic-tape playback; filtering; compositing; transferring signals from one set of tape channels to another; mixing; and correcting for weathering, elevation, and normal moveout.

Output signals from the replay console may be recorded with the self-contained CFA camera—producing a conventional galvanometer trace record on paper. In addition, the console output may be displayed on the 24-channel CIB visual display and, simultaneously, may be recorded with the CMF cross-section camera to produce variable-density or conventional galvanometer trace cross-sections.

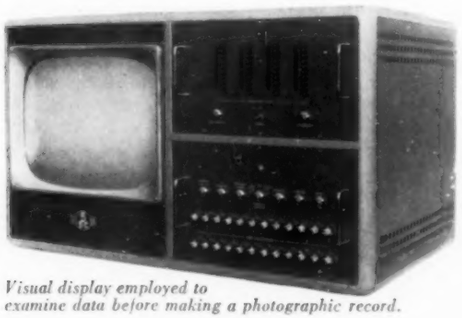
Designed as part of a seismic replay system, the CIB visual display provides for complete examination of data reproduced from magnetic tapes. It consists of a 21-in.-long persistence tube on which 24 traces may be displayed simultaneously. By observing the display tube, optimum adjustments of filtering, mixing, time corrections, and other variables are assured before making a photographic record. The resulting increase in efficiency makes this instrument invaluable in the analysis of seismic data.

The CMF cross-section camera produces photographic records of seismic data as these data are replayed from a group of magnetic tapes. When used with a tape reproducer which applies corrections for weathering, elevation, and normal moveout, the camera makes seismic cross-sections which are very valuable for interpretational purposes.

Information from the magnetic tapes is displayed in the form of successive recordings, adjacent to one another on the same photographic sheet, using either conventional galvanometer (variable-amplitude) or variable-density traces. Optionally, through the use of a suitable optical system, variable-area traces may be made. The cross-sections produced in this manner are 24 in. wide by 43 in. long—representing a recording time of 5.9 sec.

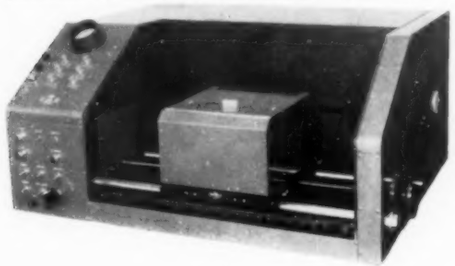
More than 100 variable-amplitude traces may be recorded, using 1 to 24 galvanometers for each successive recording. Variable-density traces are recorded singly to a total of 400. When the camera is used for sequential trace recording, the static corrections (weathering, elevation, and moveout for any given time) may be included by appropriate setting of the recording-drum position relative to the time break.

The SSC seismic replay center has the capacity to handle the field production from several field crews. Such a center located conveniently can assure that maximum information will be obtained from seismic crew operations. END



Visual display employed to examine data before making a photographic record.

Cross-section camera for the production of photographic records from magnetic tapes.



Seismic replay console.

NEW TOOLS FOR THE GEOPHYSICIST

SIE RECORD-ANALYSIS SYSTEM

An integrated seismic record-analysis system, complete in three machines, is being built by Southwestern Industrial Electronics Co. Each unit will be designed to perform certain functions. A user then may purchase only needed instruments rather than invest in a more elaborate record-analysis system than is necessary. Cost of the three machines will be no more than a single highly complex system to provide all the functions necessary in analysis of seismic records; and the complete units, when integrated, will produce any desired combination of functions.

The SIE MR-12 system is the first of these units, and is used primarily for correcting records for weathering and elevation, etc., as well as normal moveout. This machine also will develop cross-sections on pen-written records and perform certain other functions. The second machine is being designed for high-speed compositing of seismic records, and the third in this series will be a record plotter to convert magnetically recorded field tapes into depth sections.

In the MR-12 office playback system, SIE has used its experience in research and design to produce a complete standard record-interpreting system adaptable for handling both FM and "direct" recorded tapes.

The MR-12 will provide a record cross-section, pen-recorded on paper, which can be subsequently photographically reproduced. Cross-sections can be isopached or set to a desired reference plane. It also provides identical information permanently stored on magnetic tapes.

Tapes or visual records can be made with this system which have been trace-mixed, filtered, and corrected for weathering and elevation as well as normal moveout.

Filter analysis may be made of field records by playing the same record back through several filters and displaying it as a pen-written paper recording.

Several schemes of mixing can be tried on a record and observed on a pen-written paper record. Various weathering and elevation and normal moveout corrections can be tried in conjunction with this mixing. Normal moveout analysis recordings and NMO curves can be tried and displayed to determine the optimum normal moveout curves.

The system is capable of compositing field records if an optional accessory panel is used.

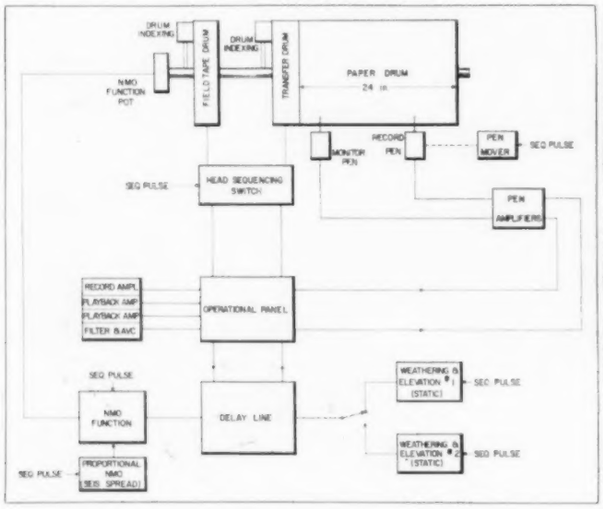
The MR-12 tape transport consists of one field tape drum, one transfer tape drum, and a wide-viewing drum—all mounted on a common driven shaft. The two standard SIE magnetic drums have adjustable combination FM and "direct" recording head banks. The third drum is a 24-in. oscillographic drum for pen recording. Two galvanometer pen writers are provided for this visual-display unit. One of these pens utilizes 2 in. of the oscillographic drum for monitoring purposes to observe time break, 100 cps reference signal, etc., information. The second galvanometer pen is used to display signal channels. The pen movement is adjustable to provide any desired horizontal scale for making cross-sections.

Mounted on the shaft of the drum assembly is a function generator potentiometer which generates the normal moveout function. The paper, or viewer drum, is mechanically coupled to the transfer drum. These two units can be indexed with respect to their common shaft so that signals recorded on the transfer drum and paper drum can be properly located with respect to a timed event (time break, isopached reflection, etc.).

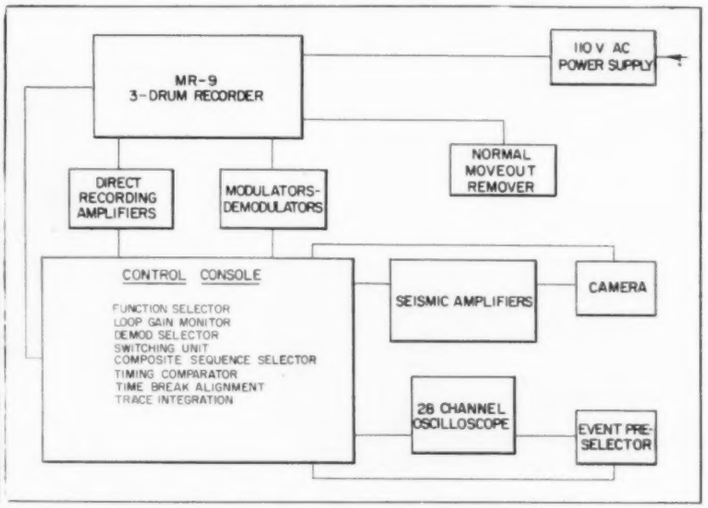
The field tape drum is also capable of being shifted with respect to the shaft. This is provided so that field recordings can be aligned properly with NMO functions generated by the NMO function potentiometer. The entire drum assembly rotates at a surface speed of 7½ in. per sec.

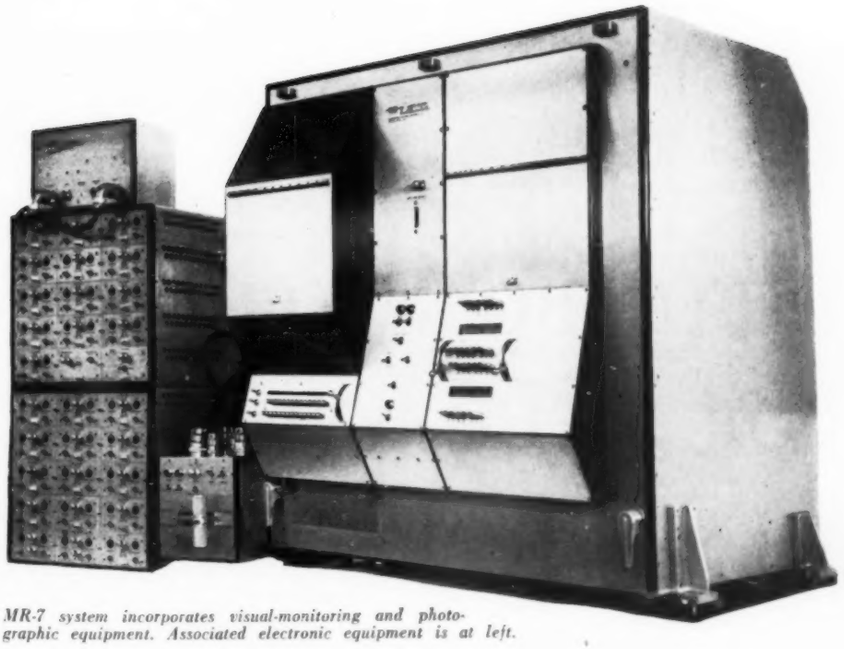
The system is entirely sequential in operation, in that it transcribes one trace at a time from the field tape to either the transfer drum or to the paper drum. This eliminates most of the many electronic amplifiers which normally are associated with analysis systems not utilizing a se-

SIE MR-12 Office Playback System.



Direct-FM Processing, Office Playback System.





MR-7 system incorporates visual-monitoring and photographic equipment. Associated electronic equipment is at left.

quential process. It also allows the use of a relatively inexpensive, small precision device for introducing time corrections one trace at a time. Since only one filter is required in the system, it may be as elaborate as desired without appreciably increasing the overall system cost. The MR-12 requires merely the addition of two playback amplifiers and one record amplifier to convert from "direct" to FM tape handling.

The MR-12 servo-control delay line provides a means for complete electronic automatic control of all time-delay functions necessary for applying time correction to seismic field records. It allows presetting of time corrections for the next record while one is being processed.

This delay line provides NMO (dynamic) and weathering and elevation, etc. (static) corrections, one trace at a time. It has a 5.500-in.-diameter magnetic oxide-coated drum rotating at approximately 3 revolutions per second with a tape speed of 50 in. per sec. One pair of recording heads is mounted in a fixed position with respect to this drum. Another pair of playback heads is mounted so the heads can be positioned at any desired point on the drum surface to provide the delay function. One of the heads in each pair is used to carry signal information, while the other provides noise cancelling. The heads are spaced approximately 0.005 in. from the recording surface of the drum to eliminate recording-head and oxide-coating wear.

A maximum delay of 250 milliseconds is provided; 100 milliseconds of this range (±50 milliseconds) is used for static corrections. The remaining 150 milliseconds is used for dynamic corrections.

The position of the playback head representing time delay is servo-controlled. A voltage, which represents time delay, is fed to the servo mechanism, and thus static corrections are fed into the delay line as constant voltages. The voltage generated by with time according to the NMO curve) is the function potentiometer (which varies fed into the delay line to provide dynamic corrections. Since all time delays are represented by voltages, precision-calibrated potentiometers are used to provide the time-delay information fed into the delay line.

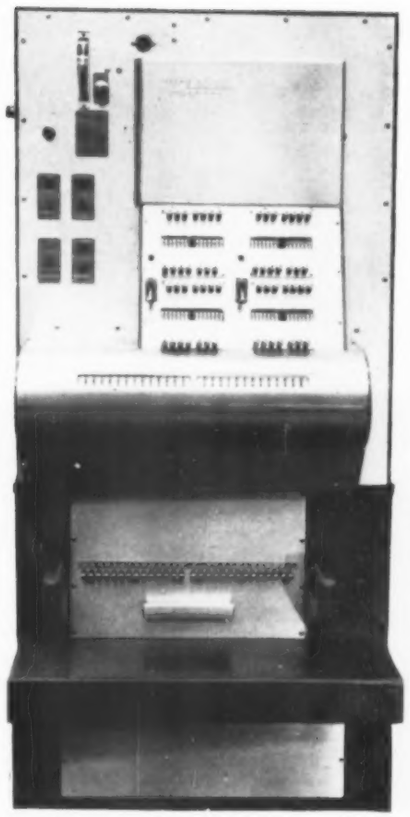
For inserting static corrections, a static correction panel is provided which has 24 potentiometers for selecting time delays for each seismic channel. Once the time delays have been set on the static panel, an automatic sequencing device feeds these time delays to the magnetic delay line. While this process is being carried out, static corrections for another location may be inserted on an additional static correction panel, so that no time will be lost in setup.

The NMO corrections are fed to the magnetic delay line by precision potentiometers calibrated in spread distance. Each potentiometer feeds to the delay line the correct proportion of NMO required for each geophone position. A precision-tap NMO function potentiometer is synchronized with the drum, and correct proportions of this function are fed by automatic sequencing to the magnetic delay line.

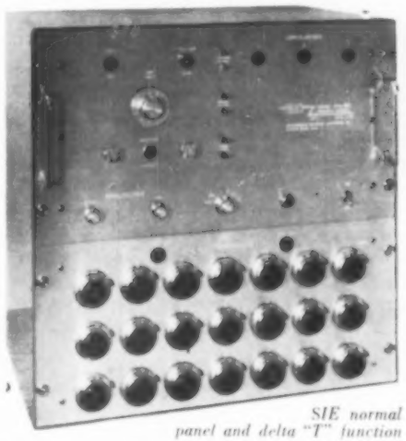
The MR-9 office playback magnetic tape machines are designed to handle either "direct" or FM recordings without changing recording heads. They are operated from a 110-volt AC power source. These machines allow compositing of 24 traces at one time, and will also duplicate tapes. Normal moveout correction is provided, and an integration system for processing recordings made with the "thumper" or weight-dropping method is incorporated. These systems can be used for direct playback; playback through amplifiers; making corrections; compositing; transferring; and trace integration.

Three tape-transport drums are used in the MR-9 system. One drum is equipped with movable heads; the other two have fixed heads. Relative motion between the movable-head drums and the fixed-head drum is provided. Drums can be run at either 3¾ or 7½ in. per sec as desired, and drum rotation may be reversed.

(Continued on page 78)



Tape transport with normal moveout remover, used for rapid compositing and phase shift correction.



SIE normal panel and delta "T" function moveout remover control simulator used with office analysis equipment.

MR-8D is a two-drum system for compositing records in the field or office.

CARTER OIL LABORATORIES DEVELOP FIELD AND OFFICE MAGNETIC MACHINES

WHEN magnetic recording of seismic data was in its infancy, The Carter Oil Co. embarked on an ambitious plan for constructing a system which would utilize magnetic recording to its fullest advantage. Since Carter Oil Laboratory is a research organization for Standard of New Jersey and its affiliates, the design of the system was influenced by a cross-section of laboratory people, geophysical interpreters, and field personnel. The aim of this project was the development of a means for obtaining a permanent reproducible tape recording of a seismic shot in the field, along with the necessary office playback apparatus to reduce the data on the field records and present it in the most revealing form for final interpretation.

The result of this effort is contained in the FR-1/MT-4 Field Recorder and Office Playback Machine, which are now being manufactured by Electro-Technical Laboratories, Division of Mandrel Industries Inc., under a license agreement with Esso Research and Engineering Co.

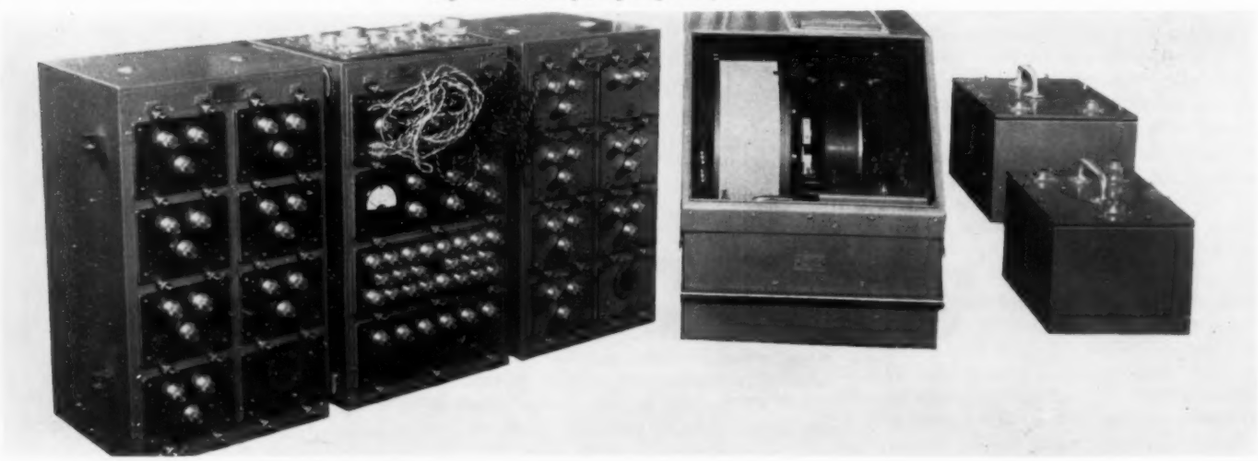
Design of the field recorder was aimed at providing a comprehensive and self-sufficient means for amplifying and recording 24 traces of seismic signals from a geophone spread in a permanent reproducible fashion with only as much amplitude control as is necessary to stay within the dynamic range of the recording medium. This is accomplished through the use of an extremely versatile fader, or suppression, circuit which allows the operator to set up a program of attenuation vs. time to match as closely as possible the energy level vs. time appearing at the input of the recording amplifiers. In addition, each recording amplifier contains an automatic gain control circuit for sompensating the error between the actual energy pattern and the set in attenuation program. During the recording process a visual monitor, consisting of a two-trace galvonometer and screen assembly, allows the operator to scan all traces, two at a time, for wind noise, amplifier balance, etc.

The actual recording medium, pulse-width modulation, was chosen for its good low-frequency response, low noise characteristics, and preservation of high signal-to-noise ratio with repeated transcriptions during the office playback process.

For field monitoring of the tape recording, a sequential playback scheme was chosen, since it requires only one playback amplifier and allows the use of a dry process display utilizing an electro-stylus on a drum of electro-sensitive paper. This, of course, eliminates the need for dark-room facilities and developing chemicals. The single playback amplifier is equipped with low-cut and high-cut filtering, as well as an AGC circuit. This, then, allows the operator to play his field recording back immediately, applying various filters and AGC constants, tc obtain a paper record which, through the built-in timing accuracy of the machine, may be used as a working record, prior to further data reduction on the MT-4 office playback machine.

In addition to the above-mentioned equipment, the FR-1 contains as input patch panel; a test unit for measuring geophone line impedance, power supply voltages, fader, and AGC control voltages; a test

Fig. 1. Units comprising magnetic field recorder.



oscillator for feeding the amplifier input with sine wave signals of various amplitudes and frequencies.

All of the equipment comprising the FR-1 field recorder is contained in six packages of rigid aluminum construction provided with covers for portable operation. The FR-1 is complete within itself, needing only batteries and geophones to complete the picture for field recording.

The MT-4 office playback machine was designed, of course, to operate on the field tapes obtained with the FR-1 field recorder. The design of the system utilizes the latest concepts in data reduction and final presentation. The basic functions of the MT-4 are as follows:

1. *Static time corrections:* Weathering and elevation time corrections may be introduced for each individual trace.

2. *Normal-moveout correction:* The time error due to spread length in a conventional seismic recording is eliminated by this machine.

3. *Shot mixing:* As many as four separate field tapes may be corrected in time and then added in any one of many available mix programs. Mixing both before and after filtering and AGC are available.

4. *Record cross-section:* A drum oscillograph available with either an electro-pen stylus, ink-pen stylus, or galvanometer may be used to develop record cross-sections with as many as 250 traces on 16-in.-wide paper.

The MT-4 consists of seven drums mounted in line on a rigid cast-aluminum bed. The left-hand set of drums includes four standard tape drums and a single-track time-correction drum. These drums are driven by a synchronous motor, and are connected to a drum oscillograph and time-break alignment drum through a three-speed gear box. The electronic control circuits, playback amplifier, filters, mix circuits, and power supplies are packaged in dustproof enclosures below the drum bed. Each of the standard tape drums is equipped with a full set of 30 recording heads which are mounted in the same manner as the heads on the FR-1 field recorder.

The field tape obtained on the FR-1 field recorder (Fig. 2) is loaded on the right-hand standard drum, which is adjustable with respect to the shaft in order to line up the time break with a given position of the shaft. The time-break alignment drum is used to effect this adjustment. The tape recording is then played back one trace at a time. The pulse-width signal from each head is reshaped in the transfer amplifier and impressed on the record head on the time-correction drum. This record head is movable by means of a calibrated hand wheel, and is used to introduce static-time corrections. The dial on the hand wheel is calibrated in milliseconds. The takeoff head on the time-correction drum is simultaneously caused to move in such a manner to correct for normal moveout. A calibrated dial on the normal moveout corrector is used to set in the distance from the shot point to the detector station corresponding to the trace being processed. Any constant average ground velocity may be assumed. The time-corrected signal from the takeoff head is then reshaped and recorded on one of the standard drums. At the same time this signal may be demodulated and fed through a playback amplifier with filters and AGC, and recorded on the drum oscillograph. This process is repeated for all traces and, except for manually setting in the static correction and spread distance for each trace, the operation is completely automatic.

Up to four time-corrected records (Fig. 4) can be composited simultaneously. Four demodulator channels are available; and, by appropriate setting of the switching circuits, any four traces on either or all four drums may be simultaneously demodulated and mixed by either of 10 available mix programs. Two playback amplifiers are provided, allowing the mix products to be filtered and AGC applied. These filters are identical to those in the FR-1 playback amplifier. The output of these two playback

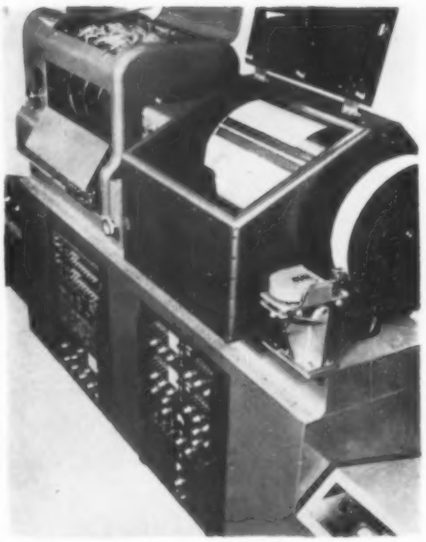


Fig. 3. Carter's office playback and data-reproduction machine.

amplifiers may be further mixed and their sum fed to the drum oscillograph. If only three records are composited, their mix product may be converted to pulse-width data and recorded on the remaining tape drum to obtain a reproducible record which may be mixed later with another similar tape record. The number of methods for compositing, then, is limited only by the operator's imagination.

The drum oscillograph is used to obtain a visual recording of the result of any of the aforementioned programs.

Three types of writing are available: pen-motor and electro-stylus; pen-motor and ink-pen; and galvanometer.

The trace spacing is adjustable, allowing as many as 250 traces on 16-in.-wide paper. Preprinted timing lines are supplied on the paper used with either the electro-stylus or ink-pen writer. For photographic display, glow-tube-produced timing lines are photographed on the final record. END

Fig. 2. Time-correction procedure.

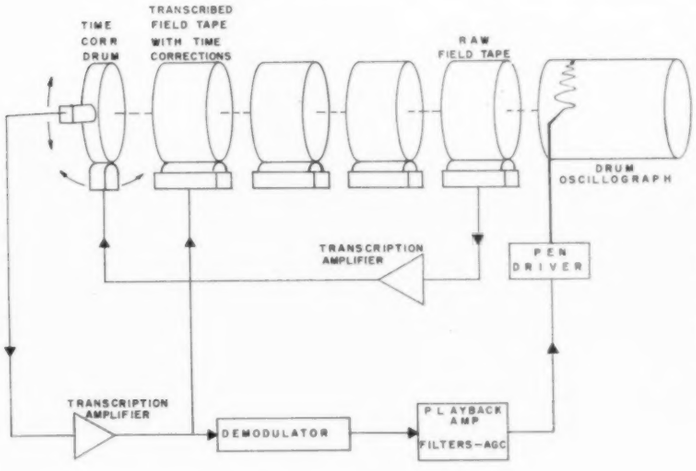
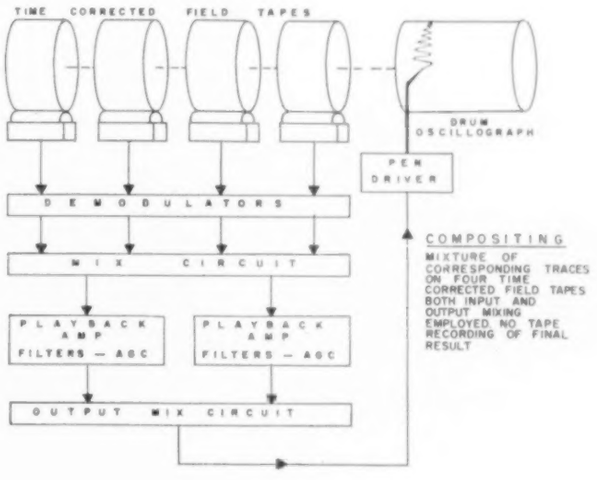


Fig. 4. Compositing procedure.


TIME CORRECTED FIELD TAPES
DRUM OSCILLOGRAPH
PEN DRIVER
DEMODULATORS
MIX CIRCUIT
PLAYBACK AMP FILTERS — AGC
PLAYBACK AMP FILTERS — AGC
OUTPUT MIX CIRCUIT
COMPOSITING
MIXTURE OF CORRESPONDING TRACES ON FOUR TIME CORRECTED FIELD TAPES BOTH INPUT AND OUTPUT MIXING EMPLOYED. NO TAPE RECORDING OF FINAL RESULT

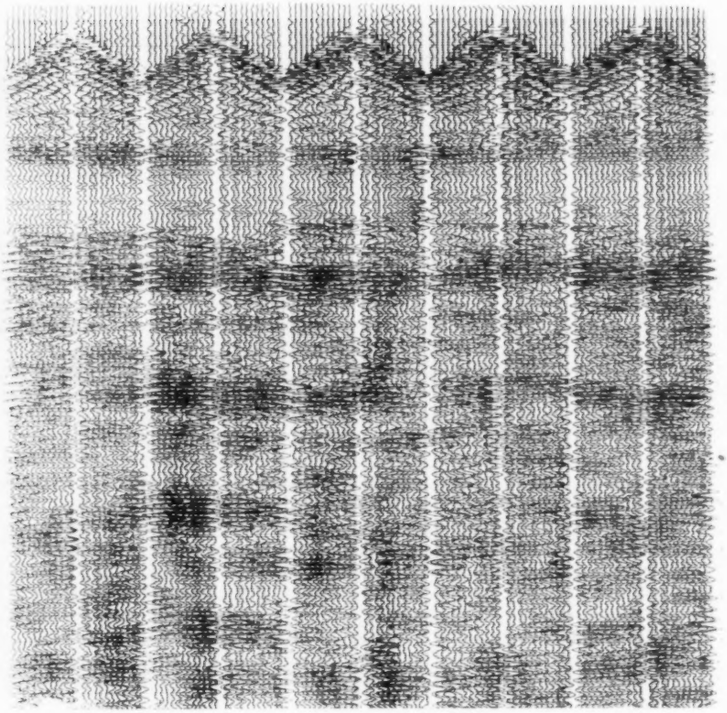


Fig. 1 A Typical record section: Shown are five 24-trace records which have been corrected and plotted with Geopac. The reflections are found to tie well between records. The records were obtained in southern Mississippi, a region often noted for difficult geophysical interpretation problems. The mixing was 30% from adjacent traces.

GEOPAC

an automatic plotter and computer for seismic geophysical data

by

*L. M. Mott-Smith, W. J. Gundlach, and G. C. Phillips**

Recently the General Geophysical Co. designed and developed an automatic device for processing seismic data. This paper describes this machine, called the Geopac, and discusses its operation.

Since many of the computational operations necessary for reducing large amounts of seismic data to a form which allows geologic interpretation are routine in nature, it was believed that a suitable automatic machine would facilitate the process of computation. The advantages to be gained by such a method are numerous. Among those worth noting are: (1) improvement in speed; (2) reduction of human error; (3) reduction of unit cost; (4) the ability to handle and to correlate large quantities of seismic data, and to present the results in the simple, organized form of a cross-section.

To understand the principles of operation of the Geopac, one may consider a typical seismic prospecting situation as is shown in Fig. 4.

The corrections to the time for seismic energy to traverse the path from shot, to reflector, to geophone is the event of primary importance recorded by the seismic detectors when an explosion is set off in the shothole. However, one needs to correct this time to correspond to a path which goes from datum plane to reflector beds to datum plane; the measurements are then normalized to datum plane which may be, for example, sea level. Also the measurements should be vertical measurements which correspond to a horizontal position about midway between the shot and the detector. To accomplish these corrections, a number of geophysical and geological factors must be considered: (1) removal of the effects of elevation variations of the geophones; (2) removal of variations of weathered zone thickness along the geophone spread; (3) elimination of "normal move out," i.e., the effect of horizontal distance from shot to detector; (4) portrayal of the results at their proper horizontal positions. The Geopac is designed for automatically, quickly, and accurately accomplishing these corrections.

THE GEOPAC—HOW IT OPERATES: To see how these corrections are accomplished, in the case of the single-layer weathered zone shown in Fig. 4, one may easily show that the first arrival events—shown as those which travel by the most nearly straight path—allow the reduction of the data for the weathering and elevating effects. Thus, if Geopac is supplied only with the basic data: elevation of shot (h_o); elevation of all the geophones ($h_1, h_2 \ldots h_{24}$); the arrival times of the first refracted events ($t_1, t_2, t_n \ldots t_{24}$), then Geopac automatically calculates the appropriate weathering and elevation correction for each trace of a 24-trace seismogram. To accomplish the "normal stepout" correction, Geopac uses the fact that the wave fronts of reflected seismic energy arrive back at the earth surface, delayed by times proportional to the square of the horizontal distance from the shot. Thus the desired correction must be proportional to the square of the distance, x_n, of shot to geophone. From velocity-depth information, the operator sets into Geopac the proper function, $F(t)$, to correct a trace at 1,000 ft from the shot. Geopac then calculates, for all 24 traces, the quantities $x_n^2\ F(t)$ which are the appropriate normal stepout corrections.

In addition to the desirable feature of correcting each trace to the datum plane, Geopac also presents a cross-section of the resulting seismic picture of the earth surveyed. This is accomplished by portraying the corrected, interleaved seismic signals on a 42-in. wide by 51-in. long piece of photographic paper. Ten corrected 24-trace records may be presented so that each trace is located to scale with respect to its actual ground position; i.e., 5 cm on the cross-section equaling 1,000 ft on the ground, as is commonly done in manual cross-section plotting. However, any other convenient scale may be used, with minor adjustments; and, by using a smaller scale, more than 10 records may be presented. Fig. 2 shows a block diagram of the Geopac, whereas various views of the Geopac are given in Fig. 3.

All calculations which the Geopac performs are in terms of electrical signals whose magnitude indicates the size of the number to be represented. The computer is the section of the device which accom-

* General Geophysical Co., Houston, Texas.

NEW TOOLS FOR THE GEOPHYSICIST

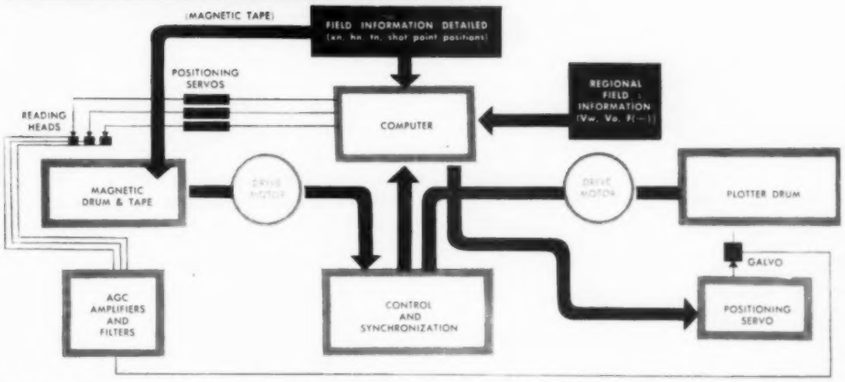


Fig. 2 Geopac block diagram: Basic regional information (velocity information, which is used for the whole area) and record information (elevations, distances, first arrivals which pertain to a particular seismic spread) are set into the computer. A magnetic tape recording of the seismic signals is placed on the magnetic drum. Servo-positioned heads read from the magnetic tape, and a galvonometer on a servo-positioned carriage prints the results on a large photographic drum. The computer controls the servo systems so that elevation, weathered zone, and normal stepout corrections are applied and the resulting time-section is to the proper horizontal scale.

plishes this. Associated with the computer are 30 potentiometers allowing any function, $F(t)$, which represents the stepout correction at a time T for a trace at 1,000 ft, to be established as a voltage changing with drum rotation. This function generation is accomplished by approximating the desired function by 30 straight-line segments. This method allows a quick resetting if areas or velocity-depth information are changed; and, since establishing the desired function does not take more than a minute, the technique is thus much more efficient than cutting cams or other mechanical systems of generating arbitrary functions; yet the method used in Geopac is of more than sufficient accuracy.

The velocity, V_w, of the weathered zone and the velocity, V_o, of the material below the weathered zone but above the datum plane are easily set by three potentiometers.

These 33 adjustments comprise what may be called regional information and, to general, will not need to be changed in any one area.

Recorded on each magnetic tape placed on the magnetic drum is the basic field information, viz., the seismic signals. These signals are read off the tape by three magnetic heads whose angular positions around the drum are determined by servo-systems which use the signals developed by the computer. To accomplish this, one must set three dials for each trace: the distance from the shot, x_n; the first arrival time, t_n; and the trace elevation h_n. These dials adjust certain voltages, and supply the computer with the necessary basic information for making an individual correction to each trace by suitably moving the reading heads on the drum.

If the corrections for weathering and elevation have been manually calculated for each trace, then only two potentiometers per trace need setting: x_n and the correction t_n. In actual practice, spread distances do not often vary, and the x dials seldom need changing.

The calculation proceeds as follows: The control system starts the process, and both drums rotate in synchronism. The three magnetic heads read in sequence traces on the magnetic record in groups of three, arranged as follows: on the first turn of the drum, traces *0, 1, 2;* on the second turn, traces *1, 2, 3;* on the third, *2, 3, 4,* etc. For each head and for each trace, the corrections are applied during the reading. By provision of three heads reading as outlined, it is possible to produce sections in which the traces up to a maximum of three can be composited or mixed in any desired proportion. A control is provided which allows the operator to apply several choices of mix from none to 100%. For this presentation, a servo-driven carriage has moved the galvonometer a lateral distance proportional to the actual distance between seismometers *1* and *2*.

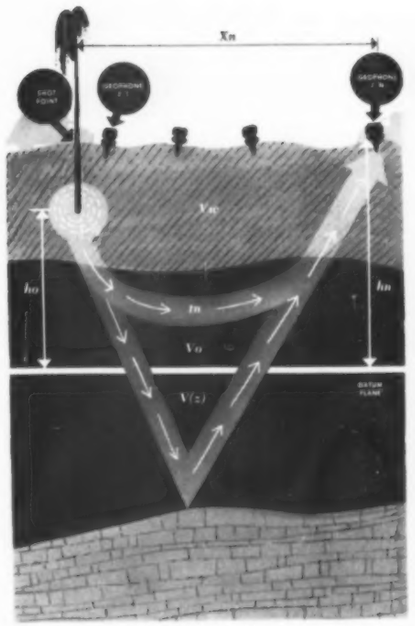


Fig. 4 A Typical seismic field situation: A charge of dynamite, in the bore hole, sends out seismic waves which penetrate the weathered zone and deeper beds which are reflected back to the surface and detected by the geophones. Since the two-way time for the waves to travel between the datum plane and the reflecting bed is the quantity of interest, corrections must be made to account for the variations of elevation of the geophone above the datum plane, variations of the weathered zone thickness, and to remove the normal stepout effects. This is accomplished for each trace by calculations using the shot and geophone elevations h_o, h_n; the geophone distances x_n; and the "first arrival" times t_n. All traces require the common information about seismic velocities; the velocity in the weathered zone, v_w; the velocity to the datum plane, v_o; and the velocity below the datum plane.

The operator may be inserting the appropriate x, t, h information for the next record while this process is occurring. The next record-tape is then installed; the distance between the last and the new shot point is inserted as a potentiometer dial setting; and the process is repeated for the next 24-trace record. The time required to compute and plot a 24-trace record is about 2½ min. Reloading and synchronization require about one additional minute. Thus, in an 8-hour day, one operator may prepare corrected cross-sections of about 100 records by using the Geopac.

Conventional timing lines are simultaneously printed for each trace section plot. Provision is made for adjusting the position of the time-break so that it accurately

Fig. 3 Photographs of the Geopac: Shown to the left is the computer and control section—The lower left dials establish the regional velocity information; the three rows of 24 dials are the distance, elevation, and time dials for each trace. The central dials are for the control operations. The central photograph shows the magnetic playback drum and the associated geophysical amplifiers. The right-hand photograph shows the plotter console.

aligns with the initial line of the timing lines on the section plot. This technique assures that all plotted records be timed properly, regardless of variation of the position of time-break on the magnetic tape. A typical cross-section of 5 records is shown in Fig. 1.

The Geopac is now in production operation, and has justified the design purposes of speed and flexibility. It is clear that, where suitably used, it will provide a more economical and efficient way of processing large quantities of seismic data and presenting them, with less error, to the seismic interpreter in a form which facilitates geologic interpretation. The features of flexibility in its application to diverse seismic problems are attractive. Probably, however, its most important contribution to the seismic prospecting technique may be expected in the presentation of *corrected data in a cross-section in which relative distances are preserved.* This feature allows the seismologist quickly to identify multiple reflections and pinch-outs, and may be expected to aid in identifying geologic faults and in quickly and accurately migrating dips of beds. The Geopac does the "dogwork" so that the seismologist may have more freedom for interpretation. END

Record Analysis

(Continued from page 73)

A cam-operated sequence timer, synchronized with the drum motion, allows the initiation and control of functions which must be controlled in time relative to drum motion, or which must be initiated at a particular point in time on the record. Traces may be stored, one trace at a time, and played back simultaneously.

The MR-5A tape transport was designed as a playback machine for use in an office analysis system. Field records can be corrected to eliminate normal moveout. A servo mechanism is incorporated in this system to synchronize the tape drums of the MR-5A with a multiple-drum storage machine for composing seismic records.

The MR-5A has two magnetic recording drums and two banks of movable heads. In addition to the normal moveout correction mechanism, static corrections may be inserted; and the drums are reversible so that reversed playbacks can be made. Speeds of 3¾ and 7½ in. per sec are available.

The MR-5B magnetic recording system is a versatile system incorporating two magnetic drums similar to those in the MR-5A. The equipment was originally installed in a field truck. A monitor or viewing drum is included to view information on the tape without having to make photographic records. The recording heads for one drum are movable, and those for the other are fixed. The two drums are used in compositing 12 traces at a time after records have been made in the field.

SIE has added also two- and three-drum systems for storage, compositing, and recording photographically or on tape.

The MR-7 is a three-drum system containing two magnetic tape drums and one large combination visual-monitoring and daylight-loading photographic drum. The drums may be run at full or half speed, and are reversible. One bank of fixed heads and one bank of movable heads are supplied, and provisions have been made for addition of normal moveout-correction mechanisms. A ±2½-sec relative motion has been provided between magnetic drums for time-break alignment. Twenty-eight modulator-demodulator units can operate simultaneously or separately, and head switching is incorporated so that recording heads may be selected as desired.

Storage of one trace at a time may be accomplished either magnetically or photographically for making condensed cross-sections. After storage on tape, all 28 traces can be recorded on photographic paper. Two banks of galvanometers are provided—one for visual monitoring and one for photographing. Each photographic galvanometer has an individual shutter which is controlled from the front panel. The photographic drum is interlocked with the magnetic drum so that lights can be energized for one revolution.

The MR-8D is a standard two-drum tape transport with provisions for composing in the office or the field. Records obtained by sequential shooting in the field can be composited 24 traces at a time. Additional switching is provided for 12 trace compositing of field records in the office. A 110-volt power supply is available to eliminate battery operation when used in an office system. END

OIL PIPE LINE PUMPS

HIGH EFFICIENCY ROBUST CONSTRUCTION
RELIABLE IN OPERATION

STANDARD RANGE OF PUMPS WITH CAPACITIES
UP TO 30,000 BARRELS PER DAY

DISCHARGE PRESSURES UP TO 1250 LB/SQ. IN.

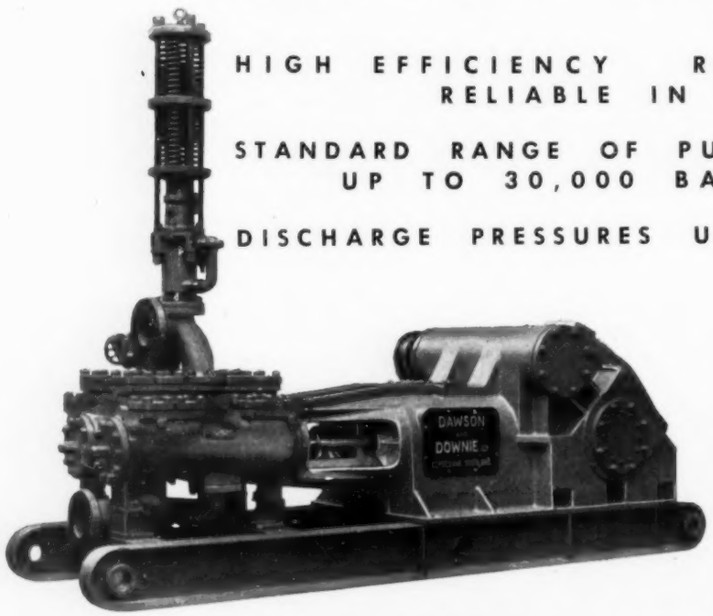
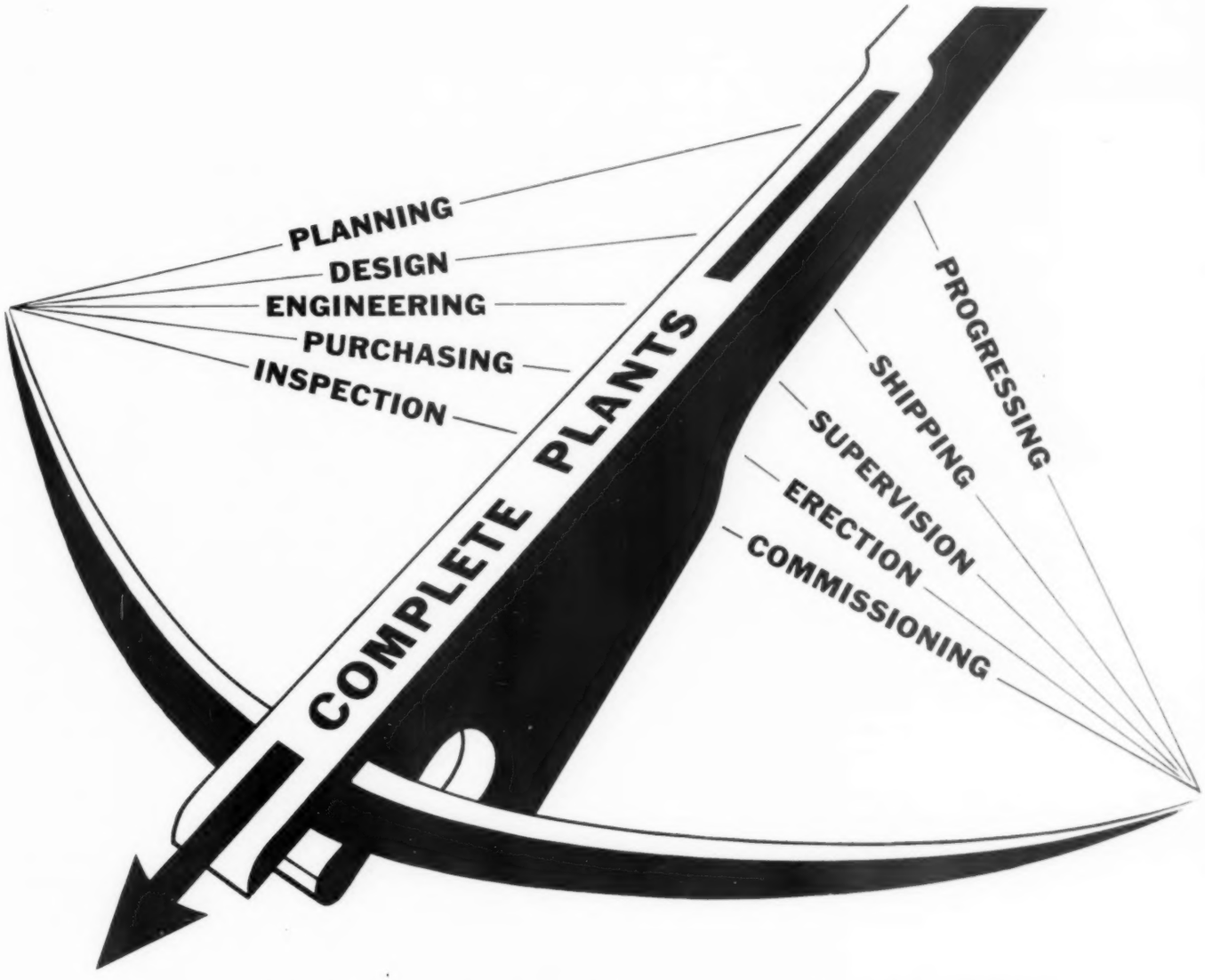


Illustration shows one of a series of pumps supplied to BRITISH PETROLEUM CO. LTD.'S refinery at ADEN, for pumping diesel and fuel oils from the refinery to the B.P. bunkering installation.

DAWSON & DOWNIE LTD

Elgin Works, CLYDEBANK
SCOTLAND

Telegrams: Pumps, Clydebank. Telephone: Clydebank 2271/2/3



MANY STRINGS TO OUR BOW

Our aim is to provide a service enabling the wide resources and experience of this company to be fully exploited by those contemplating the provision of new plant in the Chemical, Petroleum and allied fields.

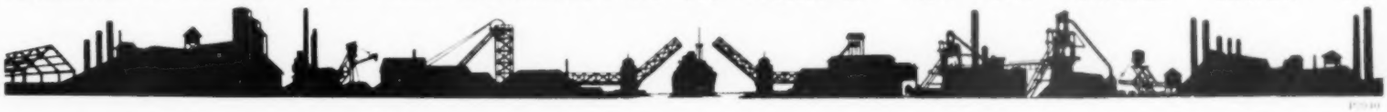
From the earliest planning to actual production we look after every detail. The need may be for a "Counterflo" cooling tower or a complete refinery or chemical plant but, large or small, the project can be handled with distinct economies in time and cost.

A further string we have is close collaboration with companies in the U.S.A. enabling American engineering knowledge to be employed where advantageous.

HEAD WRIGHTSON PROCESSES LTD

TEESDALE HOUSE 24-26 BALTIC STREET LONDON EC1

OFFICES AT PO BOX 1595 SYDNEY · PO BOX 1034 JOHANNESBURG · PO BOX 4 CALCUTTA & 603 ROYAL BANK BUILDINGS TORONTO 1
ASSOCIATES IN THE USA THE FLUOR CORPORATION LTD LOS ANGELES 22 NEW YORK CHICAGO BOSTON ETC



Central Office

(Continued from page 70)

delay necessary to approximate the normal moveout correction desired. These amounts will vary from trace to trace, but ordinarily not from record to record unless the spread geometry changes drastically.

Normal moveout switching time and time-delay amounts are, as indicated above, coded on punched-paper tape after their computation. The tape reader then furnishes coded information from the tape to memory circuits, in the program part of the system, where the corrections are automatically applied by means of head switching on the drum units. The entire operation of inserting time-correction information into the machine memory and the subsequent trace-computation procedure is entirely an automatic process for a given record. Note that one has the added flexibility of introducing the constant time corrections directly onto the punched-paper tape. Thus a paper tape serves as a file record of the corrections applied to a given seismogram.

In normal operation, the variable-time corrections (normal moveout program, for example) can be considered as a standard computer subroutine and introduced automatically into the machine; whereas the weathering and elevation-type corrections, computed as the actual data are processed, will be more likely to be set in on front panel switches. Computational units within the system combine the information stored on the rotary switches and the information from the punched-paper tape, and specify to the delay unit the proper heads to be used at any given time.

Clearly, the information necessary for the programming of the delay drum pickup-head select circuits is (1) how much delay is desired, in other words, which heads on the fast and slow-speed drums are to be used, and (2) at what instant is this delay or head switching desired?

After all traces have been processed and rerecorded on the magnetic drum, the complete record may be reproduced at any time on a paper seismogram or section in a conventional manner. A variety of mixing and compositing schemes may, of course, be applied to the corrected record in an attempt to enhance signal definition prior to making of the final record section.

Thus we see that apparatus such as the seisMAC delay unit and other analogue seismic data-processing systems provides the interpreter with a large amount of time-corrected information in a single easily-studied package. Additional manually-operated or semi-automatic devices may be constructed which permit the migration of steep dip events on these sections. Migration obviously is not easily accomplished in the playback correction procedures, since it is a post-reduction process. In other words, migration is carried out after the events have been picked.

SeisMAC is a key part of the central office for seismic data processing. The complete office provides facilities for flexible playback filtering, mixing of individual seismic traces, and compositing of traces from separate field shots, as well as for making the various time corrections. Great flexibility in compositing and mixing is attained by use of computer-type plug-in patchboards to accomplish the different types of mixing and compositing programs. The final product of the central office will be sets of records which can be assembled into cross-sections or composite cross-sections prepared by special "section cameras."

Fig. 4 illustrates typical record cross-sections prepared, using seisMAC and magneDISC equipment. Sections are prepared in either time or depth. A special oscillograph camera, the *T-Z* (time-depth) camera, shown in Fig. 5, permits preparation of depth sections according to a wide range of seismic velocity functions. Alternatively, seisMAC can be utilized to program time-to-depth conversions. Use of a "section camera" to make composite record sections on a single sheet of paper is attractive; however, often the process of optimizing the analysis operations requires many playbacks of individual records, and the method of preparing individual corrected records to be assembled into a section proves more practical.

Central-office processing of this type is but a step toward automation. A trained staff of considerable size is still required to prepare the information necessary to operate the central-office machines. This is, of course, analogous to the programming and analysis staffs required to operate the large digital computers of today, and is sure to persist for many years. It is attractive to consider, however, much more automatic equipment in which the preparation of data on corrections to be applied, and perhaps even the "picking" of the seismic records, are done automatically. Considerable research already is going on aiming at more advanced equipment of this nature. END

REFERENCES

[1] Jones, Hal J., and Morrison, John A., "Cross-Correlation Filtering," *Geophysics*, Vol. XIX, No. 4, October 1954.
[2] Jones, Hal J., Morrison, John A., Sarrafian, G. P., and Spieker, L. G., "Magnetic Delay Line Filtering," *Geophysics*, Vol. XX, No. 4, October 1955.
[3] Jones, Hal J., "Seismic Data Processing," *World Oil*, December 1956.

Weight Dropping

(Continued from page 59)

ing the transfer process. This movement duplicates the stepout curve of ($\triangle t$-T) to correct for stepout. Since drop-time corrections have been applied in the field, the analyzer applies stepout, elevation, and weathering corrections necessary in making a final corrected new tape in transfer from the raw field tape. This corrected tape is used for the integrating and photographic operation. This operation involves the playback of a preselected number of tape tracks which are demodulated from FM to the original seismic frequencies, composited electrically to a single integrated output, and then fed to the camera amplifier for filtering, automatic gain control (AGC), and suppression (if needed) before going to the galvanometer. A camera paper-holding drum is attached to the shaft of the tape drums of this machine for the purpose of photographing the composited output trace by trace into a seismogram. The appearance of this record is similar to "conventional" records, but is generally cleaner and more defined than the older, uncorrected conventional style.

Generally speaking, the more difficult record areas require higher compositing, i.e., more weight drops added per photo trace than good record areas. Composites of 80 to 96 drops per trace are not uncommon in West Texas areas, whereas 20 to 40 drops per trace are sufficient in areas such as the Gulf Coast.

To illustrate more clearly how composited records may be read, let us assume a composite of 24/20 will be used. The number "24" represents 24 drops per photographic trace, and the number "20" represents the drops overlapped from trace to trace. For example, drops 1 to 24 of any particular setup of 96 drops would be photo trace No. 1; then trace No. 2 would have drops 5 to 28; trace 3 would have 9 to 32, etc.—to give an overlap of 20 drops between successive traces. However, any composite up to 96 with any overlap combinations may be used as required. Fig. 9 shows a 24/20 cross-section composite of Gulf Coast records. Fig. 10 shows an 80/76 cross-section composite of West Texas records. Fig. 11 illustrates an 80/76 cross-section composite of Mississippi records.

NEW RESEARCH DEVELOPMENTS: To speed up further the field coverage of the weight-dropping technique, development of a land cable with built-in miniature electrodynamic geophones has been accomplished which will now allow, for the first time, the mechanized planting of these cables and phones at rates up to about five miles per hour. This new system is now being tested, and will be commercially available soon. The advantage of having both phones and cable which can be wound on reels is that it makes for a much higher speed operation, for both weight dropping and pattern shooting with conventional equipment. Fig. 12 is a photograph of this new phone before it has been attached to the land cable. Research in the weight-dropping technique is expanding rapidly—with several major oil companies actively participating, and to date some 23 units are known to be in existence.

Although the method is not a "cure-all," it is believed that its tremendous versatility and potentiality will make possible techniques and methods which will allow it to obtain equal or superior data in any area where standard seismograph is used today, at a more economical cost per mile of coverage. END

here's how Baash-Ross

PRODUCTION SAFETY JOINTS

assure important savings in production operations . . .

INSTALLED ABOVE THE PACKER—where production packers are used—to permit positive release of a tubing string should the packer become stuck.

PERMIT SELECTIVE release and maximum recovery when one or more is used in the tubing string where sanding conditions exist.

ALLOWS CHANGE in production methods quickly and easily without disturbing the packer when installed in the tubing string.

For further information write P.O. Box 1348, Houston 1, Texas or see The Composite Catalog.

BAASH-ROSS PRODUCTION SAFETY JOINTS are run in the tubing string to provide a positive means of freeing the string at the point where the Safety Joint is installed. They are designed with a unique locking type lug which permits heavy rotational loads to be transmitted through the Joint without loosening or overtightening it—yet disengagement can be made with approximately 5 turns by following a simple sequence of operations. Buy through your supply store.

BAASH ROSS
TOOL COMPANY
DIVISION OF JOY MANUFACTURING COMPANY

HOUSTON, TEXAS • ODESSA, TEXAS • LOS ANGELES, CALIFORNIA • OKLAHOMA CITY, OKLAHOMA
CANTON, OHIO • NEW YORK, NEW YORK • OLNEY, ILLINOIS • FARMINGTON, NEW MEXICO
LAFAYETTE, LOUISIANA • NEW ORLEANS, LOUISIANA
EDMONTON, ALBERTA, CANADA • MARACAIBO, VENEZUELA • LONDON, ENGLAND • PARIS, FRANCE
MEXICO, D.F. • GRENNOCK, SCOTLAND

REFINERY AND OIL COUNTRY TUBULAR GOODS

Stewarts and Lloyds can furnish a wide range of tubulars for the oil industry which includes:
Casing, tubing and line pipe to A.P.I. specifications, seamless carbon and alloy steel pipe to all relevant A.S.T.M., A.S.A. and B.S. specifications.
Butt-welding fittings to A.S.A. B16.9 and B.S. 1640.
Swaged nipples, bull plugs and nipples from A.P.I. 5L pipe.
Casing and tubing nipples from A.P.I. 5A pipe.
Fabricated pipework for most refinery and power station installations.
Also available are poles, lighting columns and commercial piping and fittings for use in refineries or fields.

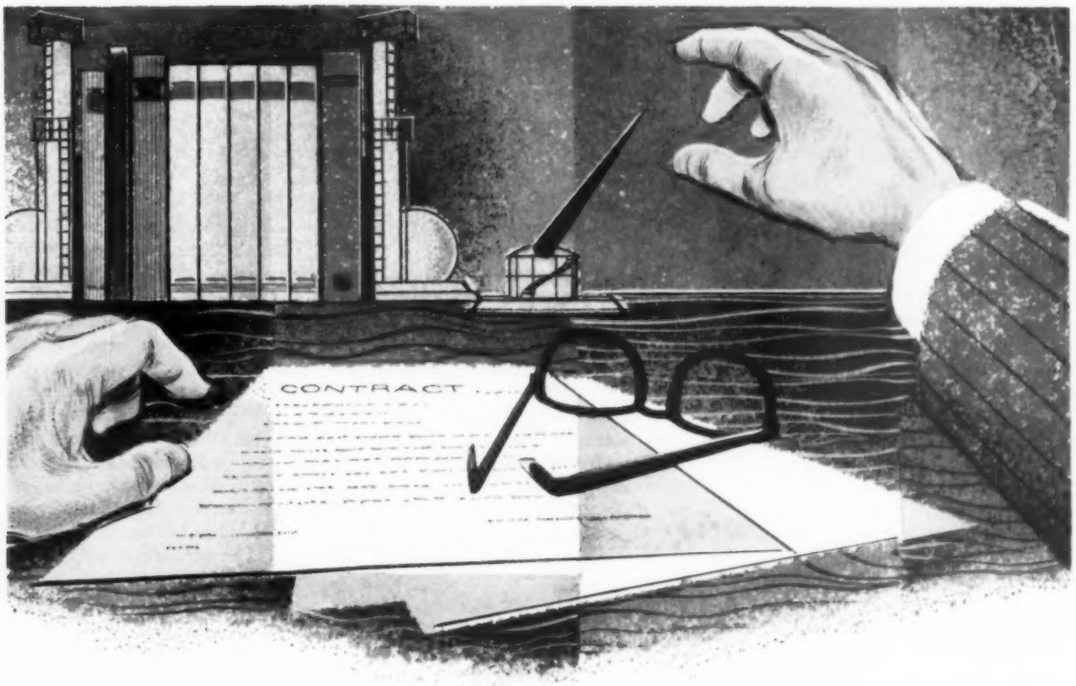
Above is shown part of the No. 2 Ethylene Plant at British Hydrocarbon Chemicals Ltd., Grangemouth.

STEWARTS AND LLOYDS LIMITED

GLASGOW · BIRMINGHAM · LONDON

A hundred years of tube making and wide experience of oil country tubulars and line pipe since the inception of the petroleum industry.

S&L



The easiest way in the world for you to ...avoid turnaround trouble!

All too frequently your need for a turnaround isn't revealed until there's an operational failure. Yet it is so easy to avoid the excessive costs and inconvenience of sudden, unplanned shut-downs.

Simply contract with Procon for a schedule of turnaround maintenance. Then your downtime can be economically planned in advance and one of Procon's experienced turnaround crews will overhaul your unit expertly and get it back on stream in the shortest possible time.

Procon men are specialists on turnarounds. We are doing more of them than any other construction firm. Our experience can provide a time-and-money saving answer to your turnaround problems. We will be glad to give you full information about it any time.

PROCON *Incorporated*
1111 MT. PROSPECT ROAD, DES PLAINES, ILLINOIS, U.S.A.

PROCON (*Canada*) LIMITED
TORONTO 18, ONTARIO, CANADA

PROCON (*Great Britain*) LIMITED
LONDON, W. C. 2, ENGLAND

WORLD-WIDE CONSTRUCTION FOR THE PETROLEUM, PETROCHEMICAL, AND CHEMICAL INDUSTRIES

NEW TOOLS FOR THE GEOPHYSICIST

THE GULF SEISMIC

The seismic profile system developed by Gulf Research & Development Co. graphically displays, on a photographically printed profile, the complete seismic data recorded along a continuous traverse. On this profile print, which constitutes a section profile of unrestricted length, the data are reproduced on closely-spaced parallel tracks as variations in photographic density. The seismic events on each of the profile tracks are printed in corrected positions with respect to a conveniently chosen datum, which is recorded as a line across the top of the section.

The corrections, applied individually on each printed track, take account of surface elevations, weathering, and other fixed factors, and of stepout, which varies progressively along the track. The effect of changing average wave-front velocity with increase in time is provided for in the stepout-correcting mechanism. Data upon which the corrections are based are quickly inserted into the mechanism on punched cards, and the entire operation of printing each of the successive field records in a specially designed printer is automatic.

The resulting profile section bears a close resemblance to a geologic cross-section, for the seismic events are distinctively displayed by the variable-density method of reproduction. The seismic picture of the entire profile may be absorbed at a glance. Paper prints, readily made from the profile film, are generally used for working out interpretation details and preparation of maps.

Fig. 1 and 2 show portions of seismic profiles made by the Gulf profile printing system, and illustrate the clarity and completeness of the information revealed along a continuous traverse. The profile of Fig. 1 approaches the flank of a shallow offshore salt dome lying to the left of the photograph; and the profile of Fig. 2 extends over a deeper dome. Timing marks indicated on the profiles at 1.0 sec, 2.0 sec, and 3.0 sec are with respect to the datum line (not shown in these views). The complete profile allows about 3.8 sec of recording time. In each photograph the bending of the sediments upward toward the salt mass is indicated clearly. In Fig. 2 the strong reflection alignments at about 1.25 sec are evidently repeated at 2.5 sec as multiple reflections (events making a second round-trip, having been reflected from the surface of the water). Events below 1.25 sec must also be multiple reflections of earlier-arriving events.

The rendition of seismic data in this manner simplifies the work of those interpreting such data; draws attention immediately to the geophysically important and noteworthy features of the data; and assures that all detail, which may be so clearly observed, is given careful consideration for its contribution to the overall seismic picture.

In numerous Gulf installations of this equipment, a special recorder and associated amplifiers are mounted in the field-recording truck alongside the conventional equipment. In this field recorder, an original film record is made from each seismic shot. These records contain precisely the same information as commonly recorded on wavy-line oscillographic-paper records, but on the film the information is represented as lighter and darker zones.

The variable-density tracks on the original field records look much like those on the profile which is eventually made from them. Corresponding to each oscillographic trace of a conventional record, there is one variable-density track or channel. On the film, 70 mm in width, there are 27 tracks side by side, 1/12 in. from center to center. Twenty-four channels are used for seismic information. The other 3 tracks are for auxiliary information, such as time break and 100-cps timing.

Tiny incandescent lamps comprise the fluctuating light sources producing the variable-density tracks. The 27 lamps are mounted in a housing having a series of small aligned slits through which steady light emerges when there is no seismic signal. During the taking of a record, the

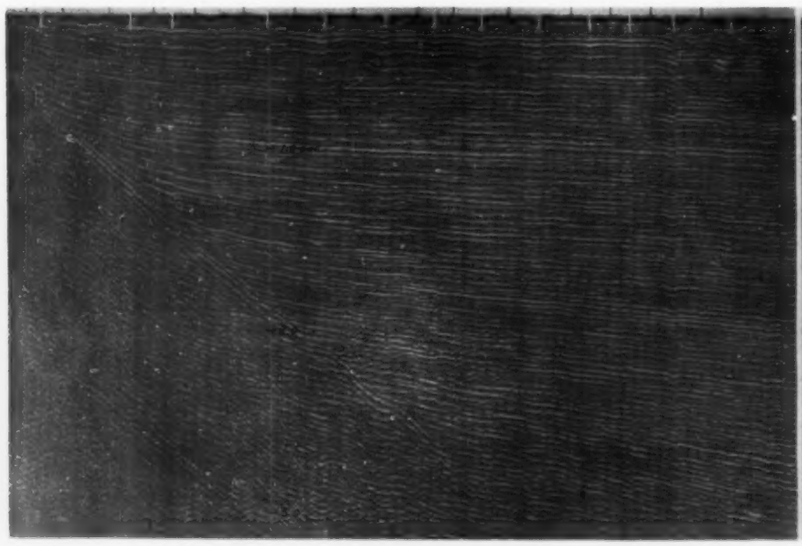


Fig. 1 Portion of seismic profile approaching the flank of a shallow offshore salt dome lying to the left of the view. The profile, displayed as a variable-density recording, was made with the Gulf seismic profile printer.

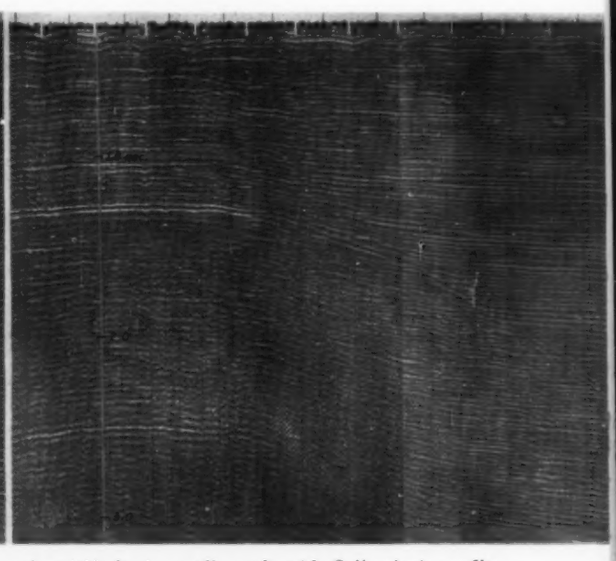


Fig. 2 Portion of variable-density profile made with Gulf seismic profile printer from seismic records shot over an offshore salt dome.

PROFILE SYSTEM

film is drawn past the recording head at a steady rate which, as chosen for the equipment, is 5 in. per sec. This exposure would produce a moderate gray photographic density on the recording film after development. Generally, however, the seismic signal raises and lowers the light output of each lamp about the mean intensity. Thus the alternating darker and lighter zones characteristic of variable-density recording are produced, and these zones correspond in their density with the valleys and peaks of oscillographic traces.

In the interpretation of oscillographic records, it has been customary in the past laboriously to plot selected seismic events in corrected position on graph paper. In distinction from this, the Gulf system employs a "profile printer," shown in Fig. 3, which applies the corrections to all events of individual tracks of successive field records, and prints the corrected events on a photographic film 20 in. wide and up to 100 ft long to form the complete profile section. In the printing steps, data reduction and various special functions are performed automatically.

The profile film, threaded around a small roller, may be seen in the foreground in Fig. 3; and, when the printer is in operation, the variable-density record is held in tangential contact with the profile film along the upper side of the roller. As a profile track is exposed, a narrow illuminated slit moves along the roller at a steady rate, and light is transmitted through the particular record track which is in contact with the film. Thus the varying densities on the record track are transferred to the profile film to form one profile track.

Before the next traverse of the illuminated slit along the roller, the record is moved sideways one track, and the film is advanced one profile increment. Accordingly, successive tracks are printed one at a time, and the process is continued for all tracks of a record and all records of a profile.

The fixed correction, which applies to the entire length of a record track, is introduced by a fixed displacement of the record along the roller, and the varying densities of the record track are appropriately displaced on the profile film. The values of the fixed correction for all tracks of a record are previously punched in a 3-in. x 4-in. card, which is inserted into the printer at the time a record is loaded. The record is displaced automatically just prior to the printing of each track in accord with the hole locations. Such corrections may exceed plus or minus 280 milliseconds relative to the chosen datum.

The variable, or stepout correction, which applies differentially along the length of a record track, is automatically calculated during the printing process. The mechanism gradually displaces the record, and progressively shifts in time the printing position of the record-track signals on the profile film. Part of the information on which the stepout correction is based is punched in a second card, which is also inserted into the printer when a record is loaded. The effect of changing wave-front velocity with increasing time along the profile track is introduced by a cam, which is appropriately shaped for the velocity conditions on the traverse. One cam only is required for the printing of all the tracks of a profile in a given area.

The basic elapsed time for the printing of a 24-track record, including the change of record and the punched cards, as required, is about 3 min, and on an average profile an operator may print from fifteen to twenty 24-track records in an hour.

The automatically recorded series of notches at the upper edge of the profiles in Fig. 1 and 2 marks off the span of the tracks of each record. A band of segments across the bottom of the profiles (below the portions shown in Fig. 1 and 2) indicates the fixed corrections as actually applied to the tracks.

Versatility in printer operation is provided both in the mechanical construction and in the electrical control circuits, for which relays are the chief control elements. For example, records may be printed with tracks taken in either order; horizontal scale for the printed section may be conveniently chosen, since the profile film is advanced in accurately metered increments, usually from 12 to 24 increments per inch of film; the choice of horizontal scale, together with use of an illuminated slit of appropriate width, allows compaction of the original seismic data with no loss in signal level—a feature often of great value to visual presentations; and, through the use of punched cards, the mechanism easily handles the variable corrections for offset shotpoints, broadside shots, and irregularly-spaced geophones with no interruption in operating routine.

Further versatility arises from the provision for automatic compositing of variable-density record tracks. In this process, each record track is printed twice, but in alternate profile-track positions—and corrections are appropriately applied to each of the tracks which contribute to the resulting double exposure. Horizontal scale of the profile may be extended by the automatic printing of each record track twice, thus forming printed tracks in pairs. In addition, the control circuits permit individual record tracks to be skipped or repeated, and blank profile increments to be inserted as desired. Indicator lamps on the main control panel show at all times the progress of the printing and related information.

The system of variable-density profile presentation of seismic data, as described, is proving to be of great value in Gulf's geophysical operations, and the merits of the system are attested by the fact that several printers are in daily use. END

Fig. 3 Gulf seismic profile printer, showing the profile-film magazine being withdrawn from its compartment, the main control panel, and some of the printing mechanism. The covers are closed when the printer is in operation

NEW TOOLS FOR THE GEOPHYSICIST

Fig. 1 All-purpose seismograph camera.

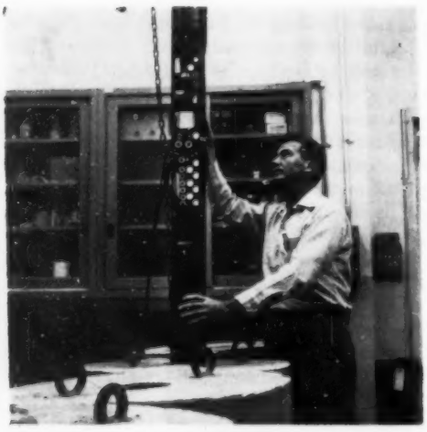


Fig. 2 "Density logger," developed by California Research Corp., is lowered into cement test blocks at La Habra laboratory.

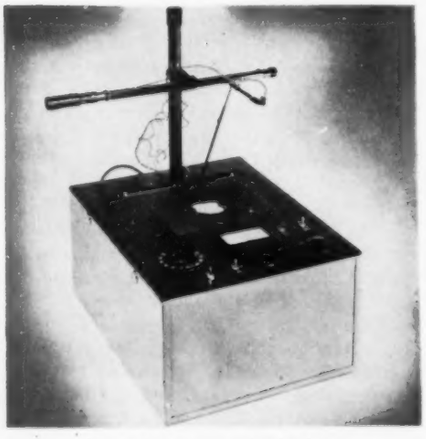


Fig. 3 Gravity anomaly simulator.

"All-Purpose" Seismograph Camera

A seismic recording oscillograph—designed to operate with all seismic recording techniques—has been developed by Houston Technical Laboratories. For high, conventional, or low-frequency seismic recording, or use with magnetic recorder, the RS-8U camera has complete operational latitude (Fig. 1).

Paper-speed changes for the respective seismic techniques are made with a flip of a control panel switch: Very low-frequency refraction—6.6 in. per sec; conventional reflection—13 in. per sec; and high-resolution reflection—32.4 in. per sec. (Paper speeds may be varied ±50% from these speeds by resetting governor.) If desired, paper speed can be switched during a record, with the change effected in 0.02 sec. Paper speed is maintained to less than 1% deviation.

Light intensity in the RS-8U camera changes automatically with each paper-speed position. Further, rheostat adjustment of both timing light and galvanometer light is provided so that the user may set intensities as desired.

Fifty 500-cps ⅛-in.-diameter galvanometers are standard in the RS-8U camera; however, 200-cps galvanometers may be specified. These are individually adjusted in the vertical and horizontal planes. An integral fork drives the timing motor to record the timing lines in normal operation, and accuracy is maintained to 1 part in 10,000. For magnetic operation, Glotubes are provided to record timing lines for a 100-cycle signal generator when used for magnetic playback. Remote start of the camera may be controlled at the magnetic recorder.

The lid of the camera is easily removed by disengaging two hinge latches, and affords easy access to the components. The cast-magnesium frame and lid assure maximum stability of optical and mechanical alignment. The camera sits atop a stainless-steel developing unit. Paper roll is loaded through the developing unit, eliminating need for any dark room. The RS-8U uses either 6-in. or 8-in. paper in 200-ft rolls, with 1⅛-in. core, emulsion side in.

The entire camera unit is 30 in. high by 12.8 in. wide, and has an overall weight of only 61 lb.

Density Logger

California Research Corp., research subsidiary of Standard Oil Co. of California, has developed a "density logger" for test-well surveys. Basic principle involved is that the proportion of gamma rays which reflect back to a radioactivity detector in the instrument varies according to the density of surrounding formations (Fig. 2).

From these radioactive tests, porosity can be figured, enabling aboveground studies of potentially oil-bearing geologic formation to be interpreted with greater accuracy.

Tests at California's research laboratories with both thick- and thin-wall blocks indicated that the gamma rays penetrate deep into surrounding formations and measure the density of formations some distance from the immediate walls of the well. This feature assures that data representative of the formation rock are obtained.

Following the "lab" tests, arrangements were made with McCullough Tool Co., of Los Angeles, to build and test a field instrument. Results of tests with the finished instrument in California, Texas, and Canada proved the device's accuracy and economy. As a result, the new density logging instrument is expected to be made available on an industrywide basis within the next few months.

Magnetic-Coated Discs

New magnetic-coated Audiodiscs, for use in geophysical exploration, computers, and other specialized data-recording work, have been announced by Audio Devices Inc., Stamford, Conn. The discs are mirror-smooth aluminum discs, precision-coated with a uniform magnetic-oxide surface in diameters ranging from 10 in. to 17¼ in.

Gravity Anomaly Simulator

The Gravity Anomaly Simulator, an instrument which simulates the effect on the earth's gravity field of a subsurface body of anomalous density has been developed by Houston Technical Laboratories to expedite the interpretation of gravity data. The instrument, measuring 24 in. x 19 in. x 31 in. and weighing only 24½ lb, can be operated on an ordinary office desk (Fig. 3).

The instrument utilizes the principle of Lambert's cosine θ law. Mathematically, it may be shown that the light integral for a horizontal layer has the same form as the gravitational integral for the same layer. By suitably scaling down all dimensions of the gravitational layer, a luminous surface of the same shape can be formed, allowing the integration to be performed by simply measuring the illumination.

In the HTL anomaly simulator, an opaque slide of paper having a cut-out opening in the outline of the desired body, is placed over a light source. The light reading is shown on a meter and combined with a multiplicative factor in determining the gravitational anomaly.

Basically, the instrument consists of a light source and measuring device. The light source is an incandescent bulb located beneath two layers of flashed opal glass. This provides a surface which approximately obeys Lambert's law. Over this, an opaque paper is placed which has a cut-out hole the same shape as the outline of a layer of the desired body.

The light-measuring device is a photocell. The output of the photocell, which is proportional to the incident light, is amplified by a duo-triode difference amplifier and read on a meter.

The photocell is mounted on a cross-arm which, in turn, is mounted on a vertical column so that a traverse may be made with a cut-out at any practical depth. By

flameproof push, lamp and switch unit

G.E.C.

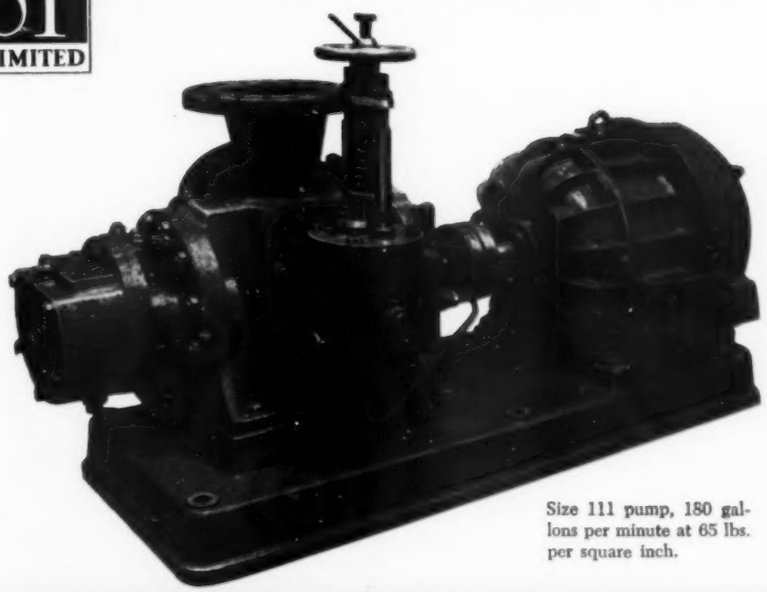
SINGLE LITEALARM

This indicator light unit, which is a new addition to our range of Litealarms, can also be used as a push lamp device for initiating or cancelling an alarm. Extra switching facilities can be incorporated for remote control of two separate circuits. Full details are available on request.

THE GENERAL ELECTRIC CO. LTD. OF ENGLAND

S&P LIMITED

AVIATION SPIRIT PUMP



Size 111 pump, 180 gallons per minute at 65 lbs. per square inch.

Ideal for handling spirit and other volatile fluids. This Screw Displacement Pump is of the all round clearance design and is capable of working with a high suction lift. The flow is practically pulseless and the unit self-priming. The high speed permits direct coupling.

The Pump will stand high shock loads and running for considerable periods against closed discharge without overheating.

Also suitable for heavy fuel and all other petroleum products.

STOTHERT & PITT LIMITED

ENGINEERS BATH ENGLAND

LONDON OFFICE 38 VICTORIA ST. S. W. I.

moving the cut-out on the table, offset traverses may be made easily.

SEISMIC TIME-DOMAIN FILTER SYSTEM

Instrumentation for linear or nonlinear filtering of noise from broad-band energy has been developed by Houston Technical Laboratories, instrumentation subsidiary of Texas Instruments Inc. This time-domain system, named the "magneFILTER," was particularly designed for the separation of desired signals from noise background (Fig. 4).

The filter is a specialized analogue computer using the cross-correlation technique. The trace to be filtered is compared at each instant of time against a filter transient which has been computed from the amplitude and phase conditions desired of a particular filter. The sum of the products of samples from both trace and the transient at any instant of time becomes a running correlation between the two. It is expected to have greatest utility as a research and design tool. With it, a wide variety of filters may be simulated, obviating actual construction of the filters. Any critical data can be examined repeatedly for optimum filtering as an aid to final interpretation.

Physically, the "magneFILTER" is a single-channel unit to be used with a multi-trace "magneDISC" by utilizing programmed sequential trace-by-trace playback. A recording head, 18 reproducing heads, and an erasing magnet are evenly spaced around the periphery of a 10-in.-diameter drum coated with red magnetic oxide. In typical operation, the filter operator length is 45 milliseconds, with head spacing or sampling points at 2.5 millisecond intervals. Associated electronics included a recording-head modulator, individual demodulators for each pickup head, individual potentiometers, and a summing amplifier. Such features as drum diameter, drum speed, finite head spacing, and other specifications of the typical filter may be altered to fit individual requirements.

The filter may be used to introduce time corrections in raw magnetic-recorded data, and for compositing seismometer group outputs with variable relative delay to emphasize signals with particular angles of incidence.

REMOTE-CONTROL GRAVITY METER

North American Geophysical Co. has completed field testing of a remote-controlled tripod gravity meter labeled the "Marsh Meter." The "Marsh Meter" bridges the gap between land and marine gravity surveys where there is marsh, mud, and shallow-water areas to be covered. The portable instrument may be transported by any means large enough to carry the desired tripod.

Remote control and indication of functions are made possible through the use of practical electrical circuits and up to 120 ft of control cable. Powered by a common 12-volt storage battery, operation may be continuous for two days before the need for recharging. Manipulation and metering are conveniently located at the control unit, which is a stainless-steel waterproof box weighing approximately 35 lb. Prime functions of this unit are remote leveling, level indicating, remote dialing and arrestment, gravity null indication, and integration.

The gravity meter proper has a control head housed in aluminum, sealed against rain and water splash and containing the leveling, dialing, and arrestment motors. This control head may be removed at will to convert the meter to the common land tripod model. A special feature of this remote meter is its dynamic range, which is approximately 20 milligals. This wide range enhances the reading ability over normal marsh and mud movements (Fig. 5 and 6).

OPTICAL ANALOGUE GRAVITY COMPUTER

An "optical analogue gravity computer" has been developed by Seismograph Service Corp., Tulsa, to aid gravity meter interpretation. The computer produces a synthetic gravity profile from geologic cross-sections. These cross-sections are simple drawings made to scale on transparent film. The geologist shades the cross-sections with a drawing pencil to indicate the geologic formations. The degree of shading represents the density of the formations being simulated.

After the geologist has prepared the cross-sections, the analogue computer is adjusted so that, when the cross-section is placed over the reading window and the meter adjusted, it displays the equivalent gravity response in a manner similar to a conventional gravity meter.

The following applications are possible according to tests:

1. Terrain and topographic corrections may be handled rapidly. This means that the computer can assist in the preparation of gravity field data.
2. The geologist can quickly check the gravity response from an assumed or real geologic section.
3. With a pencil and eraser, he can easily modify the cross-section to obtain a new synthetic gravity profile for comparison with field data.
4. The geologist can simulate the average density of any formation in the earth's crust with accuracy comparable to accepted concepts of geological density distribution.
5. He can check the validity of any conventional interpretation of gravity data.
6. He can quickly obtain the gravity solution from an unlimited variety of reasonable models.

The design of the computer is based on accepted mathematical methods of computing gravity data. This mathematical principle requires that a grid or graticule be constructed in such a way that each compartment or unit area of the graticule contributes equal increments to the gravitational field. By counting the unit areas

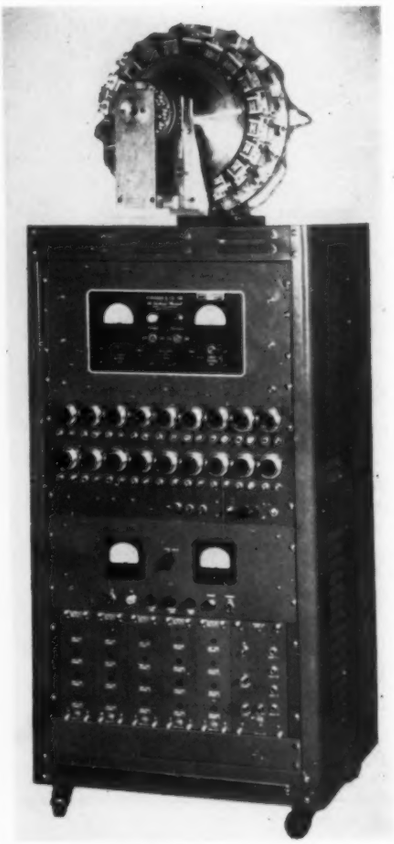


Fig. 4 "magneFILTER"—seismic time-domain filter system.

Fig. 5 Remote-control gravity meter proper.

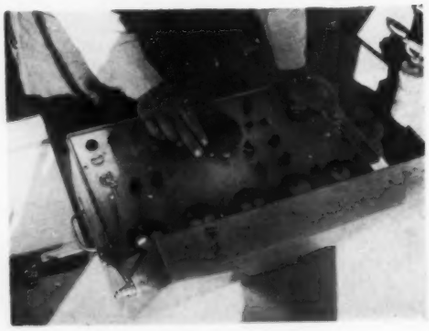
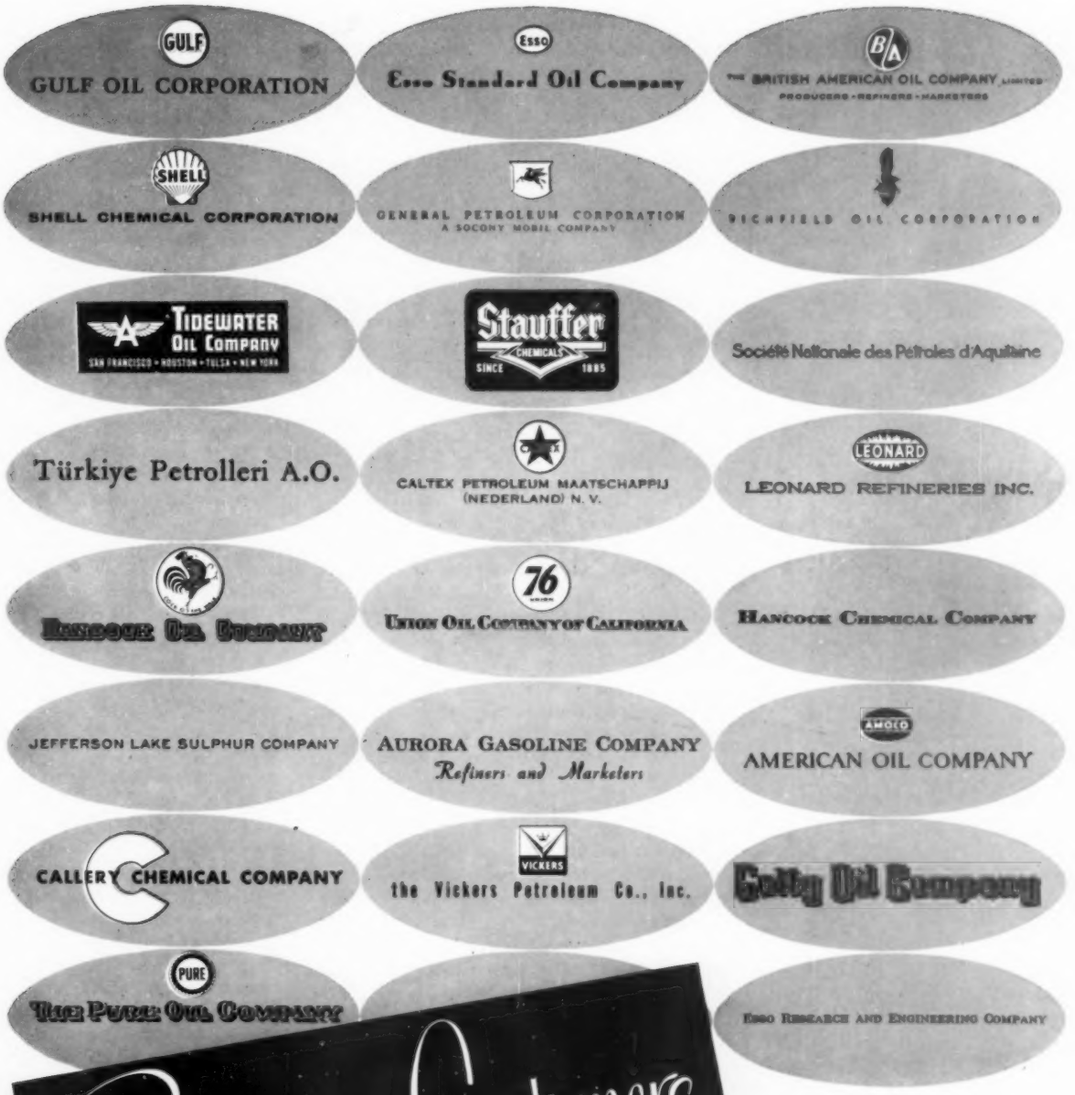


Fig. 6 Instrument control box.



Pride in our Customers

During the past year we have served some of the finest customers in the world. A few of them in the Petroleum and Chemical Industries are listed here. Our wish to all is continuing success.

PARSONS

THE RALPH M. PARSONS COMPANY

NEW YORK
PASADENA
WASHINGTON

ENGINEERS • CONSTRUCTORS
LOS ANGELES

ANKARA
BAGHDAD
BEIRUT
JEDDAH
KARACHI
NEW DELHI
PARIS

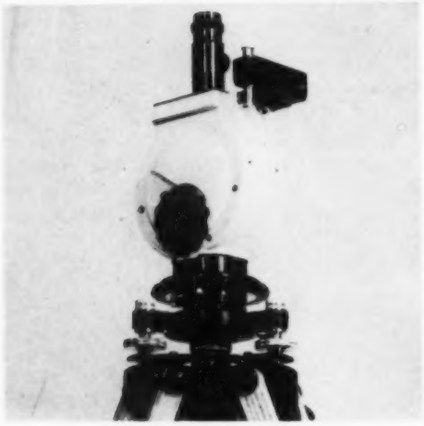


Fig. 7 Vertical-force magnetometer.

Fig 8 Recording oscillograph.

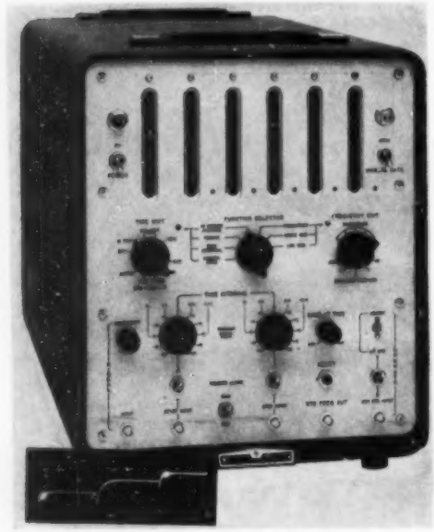


Fig. 9 Multi-purpose electronic counter

covered by the model, the gravitational attraction of the model can be calculated.

An optical graticule recognizing this mathematical requirement is provided with the analogue computer. When the geologic cross-section is superimposed on the optical graticule, a photoelectric cell in effect counts the unit areas and evaluates their densities.

The amount of light falling on the cell is proportional to the vertical component of the gravitational force field simulated by the geological cross-section. The instrument reading may be conveniently expressed in gravity unit or milligals.

Design of the analogue computer permits the use of a variety of optical grid filters—the type to be used depending on the geometrical requirements of the particular problem. The analogue computer is applicable to both two- and three-dimensional analysis.

Vertical-Force Magnetometer

Geophysical Instrument & Supply Co., Denver, has announced the Sharpe A-2 Vertical Force Magnetometer for ground surveys in petroleum exploration. It is a one-man instrument which does not require any assistant field operator because orienting compass is permanently mounted on the instrument. Sensitivity is as fine as 10 gammas per scale division and total weight, including tripod, is 13 lb. (Fig. 7).

Recording Oscillograph

Seismic Instruments Ltd., Cambridge, England, manufacturers of BER 62 recording oscillograph especially for rough field use: The chassis is constructed of black anodized aluminum, housed in a stainless-steel case. Accessibility has been maintained despite the compactness and light weight of the instrument (Fig. 8).

Each of the 25 galvanometers is independently insulated, and may be adjusted individually. The paper-storage magazine is designed for simple and rapid loading. A governor on the motor controls paper speed within close limits.

Electronic Counter

A new multipurpose electronic counter measuring frequency 10 cps to 1.1 MC, period 0.00001 cps to 10 KC, and time interval 3 microseconds to 27.8 hours has been announced by Hewlett-Packard Co. (Fig. 9).

The new counter, model 523B, presents direct-reading results in seconds, milliseconds, microseconds, or kilocycles. Accuracy of frequency measurement is ±1 count ±crystal stability of 2 parts per million per week. A special pulse output permits Z-axis modulation of an oscilloscope to visually observe time-interval start and stop points on an input waveform, shown in the figure as bright spots on the input signal.

The instrument includes a wide selection of gating and display times, or may be controlled manually. An automatic illuminated decimal points facilitates interpretation.

The use of compact etched circuitry and conservative component ratings increases both reliability and portability. The etched circuits are laid out for optimum visibility, and their sectionalized design together with trouble localizing lights in the circuit greatly eases servicing.

Recording and Playback System

The Texas Division, Brush Electronics Co., and the development group of Brush Electronics Co., of Cleveland, Ohio, have, after several years of research, development, and field testing, produced a magnetic recording, reproducing, and analyzing system of which several have been delivered for commercial use.

The Model TR-2 recording system produces a permanent, broad-band seismic record, recorded on a magnetic tape. This permanent magnetic-tape recording may be "played back" as many times as desired, with various filtering and mixing each time. The "playback" is accomplished without affecting the original field tape.

The system also utilizes a permanent electric, direct-writing monitor. The monitor record is written on a 6-in.-wide teledeltos paper chart for determining the record quality and to see if the equipment is functioning properly. In offshore work, where the time interval between shots is usually very short, provisions have been made so that only the control traces, *1, 12, 13,* and *24* can be monitored from 6 different tapes onto one teledeltos chart.

The 25-galvanometer viewing system provides a visual monitor with the light coming out horizontally through a ground-glass viewing strip at convenient eye level. The signal input to the galvanometers is from the output of the amplifiers, and is in parallel with the signal inputs to the FM modulators. This permits monitoring the traces just as with a conventional camera.

The permanent monitor-record system is a direct-writing electric pen-motor type of monitor. Six-inch-wide teledeltos tape is used on the monitor drum which is mounted on the same shaft as the tape record drum. As soon as the shot record has been made on the tape, the recorder is switched to playback, and the monitor is written sequentially, channel by channel. A system is also provided to write only the control traces, *1, 12, 13,* and *24,* from 6 different tapes onto one monitor record.

The models MRA-1 and MRA-2 magnetic record analyzers for central-office or field-laboratory use provide, as an end result, the visual photographic record of one or many field tapes with correcting, compositing, filtering, and mixing.

The model MRA-1 inserts the constant (weathering and elevation) corrections. It provides time-section photographic records with these constant corrections. It composites any number of tapes shot with the same spread and same shot hole (different

BP DRILLS 1,000,000 FT. IN BRITAIN

TWENTY YEARS AGO The British Petroleum Company started the search for oil in Britain and began production in 1939 to make a timely addition to wartime supplies. Now more than a million feet have been drilled in Britain by the BP Group.

Two of our producing oilfields were discovered since the war. These are at Plungar in Leicestershire and Egmanton, Nottinghamshire.

In 1956 some 500,000 barrels of crude oil came from Britain's 214 producing wells—most of them in the Nottingham area—bringing up the total quantity produced from English oilfields to 7,250,000 barrels. A very worthwhile contribution to Britain's ever-growing need for oil and oil-products.

The BP Shield is the symbol of the world-wide organisation of

The British Petroleum Company Limited

BRITANNIC HOUSE · FINSBURY CIRCUS · LONDON, E.C.2

Fig. 10 HTL recti/riter.

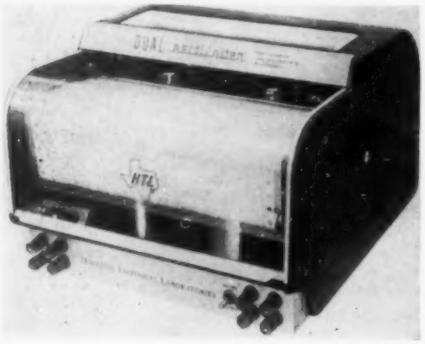


Fig. 11 DUAL recti/riter.

Fig. 12 Continuous Velocity Log-Scale Converter

depths). A broad selection of filtering and two types of mixing are available.

The model MRA-2 inserts the variable (stepout) corrections as well as the constant corrections. It provides either time-section or depth-section photographic records with all corrections inserted. It composites any number of tapes shot with the same spread and different shot-hole locations and depths. A broad selection of filtering and two types of mixing are available.

CENTRAL-OFFICE SYSTEM SPEEDS SEISMATION

"Seismation", was greatly boosted in 1956 with the development of a central-office system of seismic-data reduction built around seisMAC. The seisMAC, engineered and manufactured by the Industrial Instrumentation Division of Texas Instruments Inc., is a special-purpose computer for making both constant (weathering and elevation) and variable (normal moveout) time corrections in seismic data played back from a magneDISC or other magnetic recorder. This function eliminates much of the tedium, time, and error involved in preliminary computations—giving valuable interpretation personnel more time for analyzing data (Fig. 10 and 11).

The Industrial Instrumentation Division formerly was Houston Technical Laboratories, a subsidiary of Texas Instruments Inc.

A seisMAC central office will be able to handle data collected by from 3 to 10 crews a day, depending on crew production.

Seismic records, a trace at a time, are fed through the system and rerecorded on a magneDISC or other magnetic recording medium. The seisMAC provides for adjustment to 28 seismic data channels—24 for data and 4 for auxiliary—and can correct all 28 channels in about 2.5 min.

The seisMAC was introduced at the New Orleans SEG show, and is now operating in several central offices built around it.

The seisMAC is an extension of the "seismation" concept of more efficient use of skilled data-interpretation personnel and, as such, fits into the Texas Instruments development program along with the 7000 B all-purpose seismograph and the magneDISC data-recording system.

In addition to seisMAC, Texas Instruments developed and is marketing the *recti/riter* and the *DUAL recti/riter*, single-channel and two-channel rectilinear recording galvanometers. Geophysical exploration applications include permanent recording of scintillation counters, well logging, and offshore-location plotting.

The *recti/riter* is the first rectilinear recording galvanometer. The standard recorder has a one-milliamp range with a full 4½-in. scale 0.25-sec. rise time. AC, DC, and spring-drive models are available with a gear-shift 10-speed transmission for chart speeds ranging from 0.75 in. an hour to 12 in. per min.

CONTINUOUS VELOCITY LOG-SCALE CONVERTER

The oil industry's growing acceptance of the velocity log as an important exploration tool has led to the development of a scale converter especially designed for continuous velocity logging. This instrument is manufactured by Seismograph Service Corp., Tulsa, under license from Magnolia Petroleum Co. (Fig. 12).

The scale converter provides valuable information by performing a variety of vertical and horizontal scale conversions while tracking the original field log. In addition, it will produce a variable-area film from which synthetic seismic reflections may be generated.

The following special logs may be obtained by tracking the interval-velocity curve of a continuous velocity log:

1. A log of the velocity on a linear scale.
2. A log and film strip of the logarithm of the interval velocity drawn vs. either time or depth. These logs provide information useful for determining the indexes of reflective capability.
3. A log indicating the total travel time of a seismic reflection from a selected datum plane to any subsurface depth.
4. A log of the average velocity to any subsurface depth.
5. A log of the interval velocity in an expanded or reduced velocity scale.

The depth logs may be in scales of either 20 ft, 40 ft, 50 ft, or 100 ft per inch of chart paper.

These special logs provide data to enable the geologist and geophysicist to:

1. Make a more positive identification of the reflection horizons.
2. Study the nature of seismic reflection phenomena, as to origin and character.
3. Make detailed correlation and porosity studies.
4. Make possible direct correlations with other types of bore-hole logs originally taken to different scales.

The scale converter may be used to change the vertical and horizontal scales of any logs or any other type of plotted data, and is thus not limited to velocity log applications.

FLYING LABORATORY

A flying laboratory has been developed by the geophysical department of Newmont Exploration Ltd., New York, for Aero Service Co. Installed in a Sikorsky S-55 helicopter, the flying laboratory carries three aerial exploration instruments, viz., an electromagnetic detector, scintillation counter, and magnetometer, as well as a radio altimeter and a camera with an extremely wide-angle lens. The instruments record all signals on a single recorder chart, which is convenient for on-the-spot interpretation. All instruments are mounted directly on the aircraft—thus eliminating the dangers and difficulties of trailing a "bird."

The equipment is sufficiently automatic that an operator is not required. Periodic checks by the navigator insure that the equipment is functioning. Range of the helicopter is about 4 hours' flying time—with operations feasible in areas at altitudes of 6,000 ft and higher at reduced range. It is claimed it can explore more terrain in one day than ground crews could cover in months.

TAPE RECORDER

Ampex Corp. has designed a new instrumentation tape recorder (FR 100) of broad scope in an effort to provide an instrument which can be adapted by users to individual needs. It is the successor to more than 900 different versions manufactured to meet the needs of individual users. The FR 100 retains virtually none of the "hard-

The world's population is growing steadily and each new person requires the use of energy to feed, clothe, and house him.... There is a widespread growth in the desire of people to live better, to get more out of life. All of this calls for more energy.

—M. J. Rathbone, President, Standard Oil Company (New Jersey)

Esso 75 YEARS

producing energy for an abundant life

STANDARD OIL COMPANY (NEW JERSEY)

AND AFFILIATED COMPANIES

NEW TOOLS FOR THE GEOPHYSICIST

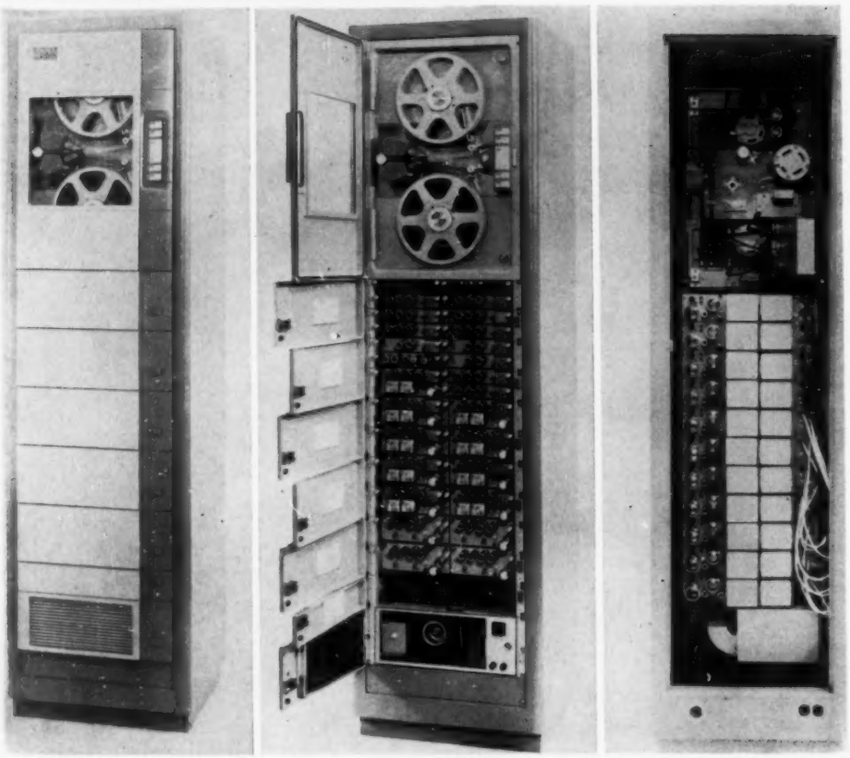
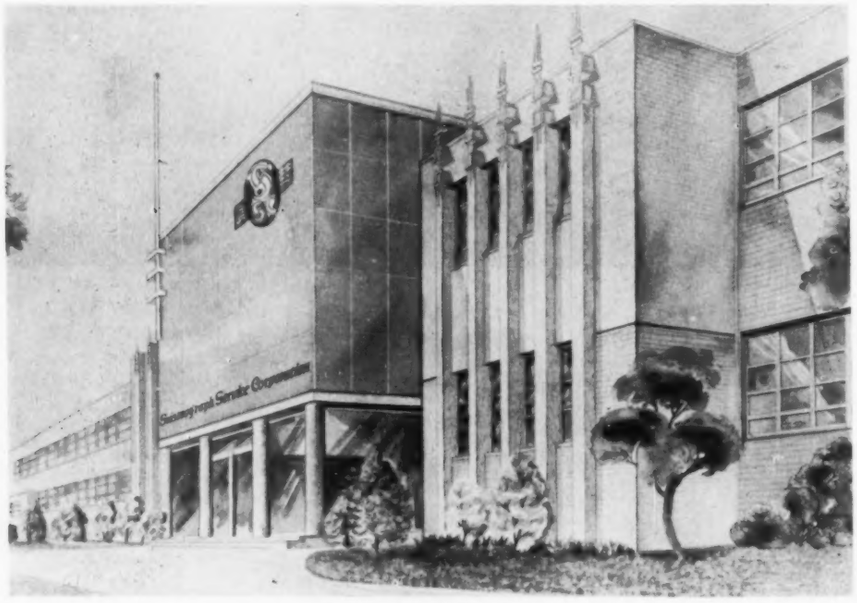


Fig. 13 Ampex FR 100 equipment is designed in modules for flexible operation, ease of maintenance, and simplicity of stocking spare parts.

ware" of previous models, but is compatible with previous instruments still in service, so that tape may be interchanged (Fig. 13).

The recorder is completely modular in construction for easy maintenance and charges which may become desirable in the future to minimize or prevent early obsolescence. The dustproof enclosure is further protected by filters for cooling air. It is designed for easy accessibility to any part.

Tape speeds may be changed from 1⅞ in. to 60 in. per second. By rerecording records may be expanded as much as 1,024 to 1. Conversely, the data may be greatly compressed. Flutter, timing accuracy, amplifier performance, and other features have been improved as compared with earlier models.



SSC new Tulsa headquarters.

Multiplier Phototube

Subterranean areas, previously inaccessible, can now be reached and probed for vital information in oil-field surveys and other investigations where structural properties of subsurface strata must be identified.

A new ¾-in. multiplier phototube, capable of multiplying a signal several hundred thousand times, has been developed by Allen B. Du Mont Laboratories, according to Dr. B. R. Linden, chief of multiplier phototube research for the company. Rated average gain for this 10-stage tube is 300,000 at 105 volts per stage.

SSC Builds New Home

Seismograph Service Corp., has opened a new $900,000 Tulsa headquarters at 6200 E. 41st St., Tulsa, Okla. Personnel and equipment from seven separate Tulsa locations are now at one central point, and the move will mark the first time the entire Tulsa organization has been under one roof since its early growth.

Climaxing the celebration of the firm's 25th year, occupation of the new seismic center affords the company some 70,000 sq. ft. of research and manufacturing space. The main building, a two-story structure, houses SSC's general offices, seismograph, LORAC, and other electronic laboratories.

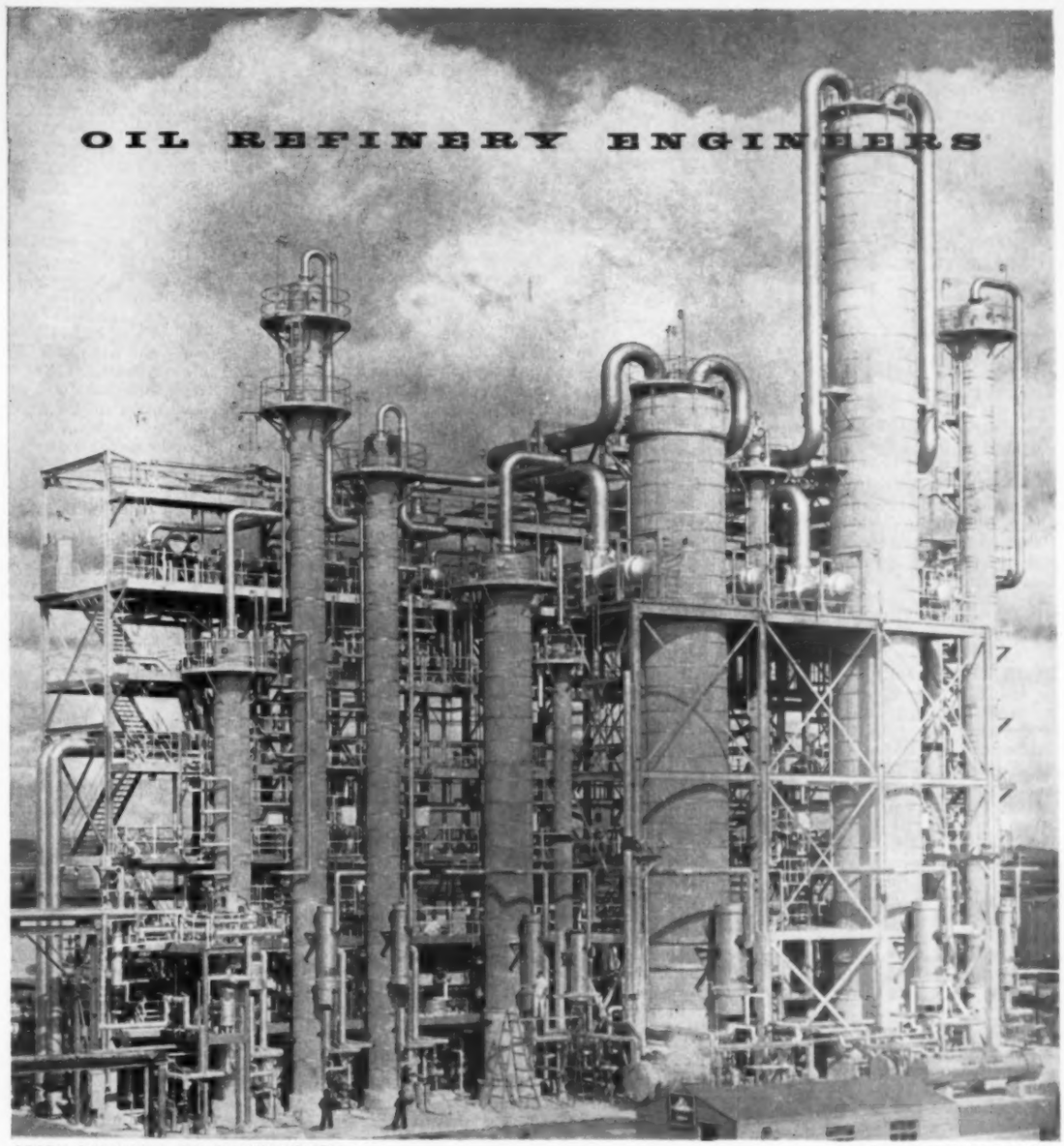
Gerald H. Westby, who has been president of SSC since 1935, joined the company 2 years after it had been organized. "Three years after we organized we had crews in Poland and Romania," Mr. Westby recalls. "That's when we first considered ourselves truly international." Today SSC is the largest seismic contractor in South America —with four crews operating in Brazil, five in Venezuela, and two in Colombia. It is now operating in 22 countries on 5 continents, and has subsidiaries in England, France, Italy, Libya, Colombia, Brazil, Bolivia, Mexico, Venezuela, and Canada.

The British subsidiary, Seismograph Service Ltd., has headquarters on a famous estate at Holwood, England. Located 15 miles southeast of London, the 105-room manor house is the former home of one of England's famous prime ministers, William Pitt the Younger.

One of the company's outstanding developments in the equipment field is LORAC (long-range accuracy), a system for locating exactly points where geophysical observations are made.

This system has been widely used in the Gulf of Mexico in the development of the offshore oil fields.

Another important development which SSC offers to its clients is "continuous velocity logging," developed by Magnolia Petroleum Co.'s field research laboratory. The technique has been licensed to SSC since 1952. Through its worldwide operations, SSC has applied CVL to a wide variety of geological provinces in North and South America, and in Europe.



FORTH CHEMICALS LTD. GRANGEMOUTH. ERECTED BY MATTHEW HALL

THE

MATTHEW HALL

GROUP OF COMPANIES

ESTD. 1848

MATTHEW HALL HOUSE, DORSET SQUARE, LONDON N.W.1

Big Oil

(Continued from page 51)

Ecuador

There have been no major exploratory discoveries in Ecuador recently. The principal exploring company is Standard Oil Co. of California, through its Ecuadorian subsidiary.

Brazil

Brazil is currently following up her vigorous exploration campaign through the government's Petrobras, covering a huge area and one which in many sections is virtually unknown.

Geological and geophysical work is proceeding in six basins, viz., Amazon, Maranhao-Piaui, Rio Grande do Norte, Alagoas-Sergipe,. Bahia, and Parana. A seismograph team is also working offshore on the east coast, beginning will All Saints Bay, at Bahia.

During the first 9 months of 1956 the number of teams operating—geological, seismograph, and gravimetric—was raised to 32 from 19, and 5 more began exploration work in other areas of the south and west center. Research will cover the southwestern region of Sao Paulo, the eastern part of Mato Grosso and South Brazil, covering the Parana and Uruguayan basins.

Early in 1956 oil and gas shows were obtained from the Testa Branca well in Maranhao at a depth of 4,220 ft to 4,240 ft. A previous deep test in the Maranhao basin, Vg-1R-Ma, on a surface geologic and seismic prospect, 55 miles east of Carolina, was dry in the Devonian at 9,476 ft.

The Parana basin was tested unsuccessfully by J-1-Pr, a new-field wildcat drilled approximately 300 miles west of Sao Paulo. It reached a total depth of 8,809 ft, believed to be the Devonian. This is the second unsuccessful deep test of this basin.

The Petrobras program, which is under the geological direction of Walter Link, formerly of Standard Oil Co. (N.J.), aims at 1,454 wells by 1960. Even this total is small when compared with the area to be explored.

Cuba

Although reconnaissance has been active in Cuba for more than a year and a number of deep tests have been drilled, no large producers have been brought in. Cuban American's No. 1 Catalina, 2 miles south of the Jatibonico field, caused excitement with a drill-stem test indicating an 800-bbl to 1,000-bbl producer of 32.9 gravity oil in the Upper Cretaceous. On completion it yielded only 25 b/d to 50 b/d.

A recent Union Oil of California and Reiter-Foster (New York) agreement on a 900,000-acre exploration and development concession calls for 50% interest in Reiter-Foster's holdings in exchange for development by Union, which has already drilled 2 wildcats. Reiter-Foster is to retain 2½% overriding royalty in any oil or gas produced, and each company is to have a half interest in any further holdings acquired by either.

Cuban Stanolind Oil Co. recently started its first well in Cuba, and staked location for a second.

The first test is Cuban Stanolind 1 Los Chivos, some 4 miles north of Alto Songo in Oriente province. The second well will be Cuban Stanolind 1 Ermita on the Sierra de Canasta in the Guantanama area.

Costa Rica

Union Oil Co. plans to drill more exploration wells in Costa Rica, offsetting its discovery of Cocoles No. 2 during 1956. A budget of $2 million has been set aside for the venture and one well, Cocoles No. 3, has been spudded. The discovery well, Cocoles No. 2, stimulated interest in the area, especially in Panama where Union is currently drilling another test, but the discovery is not yet classified as commercial.

Puerto Rico

An exploration concession was granted in 1956 to Frank Crerie, of Texas, on 7,746 acres, in alternate lease units in a checkerboard pattern, within a block comprising 49 lease units of 158 acres each. The concession is on the south coast of the island. No drilling has been undertaken on this lease as yet.

Bahama Islands

At present there are four companies exploring. Bahama California Oil, owned by Standard Oil Co. of California, and Bahamas Exploration Co., owned by Gulf Oil Corp., initiated joint seismic work in the Cal Say area of about 1,700 square miles early in 1956. Bahama National Oil Co., an affiliate of National Oil Co. of California and Bahamas Sun Production Co., obtained a concession during 1956.

Guatemala

In Guatemala the rush for concessions has nearly ended, although recently three new concessions were received in the Izabal area, going to Story J. Sloane, and Signal Oil and Gas Co. Aero Service Corp. is flying a Shoran-guided airborne magnetometer survey over 40,000 q. km. of the Peten area, working for 15 oil companies. The work will be completed about next October.

Trinidad

The outstanding recent exploratory development was the discovery of an offshore well by Trinidad Northern Areas Ltd., a subsidiary of Royal Dutch-Shell Group, D'Arcy Exploration Co. (British Petroleum), and Trinidad Petroleum Development Co. Ltd. This well, the first offshore producer for Trinidad, was begun in the summer of 1954 in the Gulf of Paria, 6 miles off Cedros Point on the southwestern corner of the island. It was completed as a "typical Trinidad well" in mid-1955. Production was reported, in the press, at 160 b/d—far above the Trinidad average production per well. Two deviated wells were drilled from the offshore platform during 1956. Trinidad Northern Areas brought in Fortin 11, offshore, as a dual completion.

Alaska

Among the companies exploring in Alaska are Phillips Petroleum Co. (with Kerr-McGee Oil Industries), Shell Oil, Ohio Oil, Richfield Oil, Sunray Mid-Continent Oil, General Petroleum Co., Union Oil of California, Standard Oil Co. of California, Colorado Oil and Gas Co., and Texota Oil Co. There are many leases held by smaller operators as well, and the list of Alaskan companies is long. They are joined by such independent companies as Havenstrite Oil Co., Anchorage Gas and Oil, Alaska Oil and Gas Co., and Alaska Gulf Oil Co.

The three principal areas of interest are the Katalla-Yakataga area which is at the northern end of the Gulf of Alaska, the Kenai Peninsula to the east of Cook Inlet, and the Koykuk Basin, west of Fairbanks. The Kenai Peninsula is seeing its first deep exploratory well, which was scheduled to start the first of this month. The exploring company is Richfield Oil Corp., and the location of the projected 8,000 ft test is the Kenai National Moose Range, on a unitized 100,000-acre Swanson River block near the northern end of the peninsula. About 88% of the acreage is Richmond's, the remaining participation is by Union Oil and Ohio Oil, with Sunray Mid-Continent contributing dry-hole money since it controls a 50% checkerboard. Phillips has a block joining the unit on the east side. Richfield has a total of 173,060 net acres under lease option.

Another recent development is the Koyukuk basin test which is scheduled for about June 15, the first possible spudding date before streams have thawed in order that cat-trains may pass Texota Oil Co., from Denver, Colorado, affiliated with F. Kirk Johnson interests of Fort Worth, holds leases on a block of 400,000 acres on the Kateel River, north of its junction with the Koyukuk River. Associates in this holding include actor James Stewart and his wife. In 1956 Texota leased about 112,000 acres further south in the vicinity of the junction of the Koyukuk and Yukon rivers.

Both areas have had ground and photogeologic work done. eGophoto Services, Denver, has completed photogeologic mapping of the areas involved. The location has been selected on the north bank of the Yukon River on the basis of surface geology and a reversal of as much as 4,000 ft is evident in the structure to be tested.

The Koyukuk Cretaceous basin contains sediments of as much as 25,000 ft in depth, of which the upper 7,500 ft are regarded as most likely to contain gas or oil. This is the first test in the interior, where there has been little exploratory effort previously.

Phillips Petroleum Co. has continued active exploration on its 1,023,000 acres largely assembled by Northern Development Co. on the Kenai Peninsula. Phillips has an agreement with the government to drill 12 exploratory wells during the 10-year period beginning in 1953. The company's third well is now being completed, with "some shows" reported at about 10,000 feet. No details have been received.

Lands rented in Alaska have gone for from 65 cents to $2.00 per acre, with overrides in the vicinity of 5%. The government's royalties are fixed at 5% for the first ten years following discovery, and advance thereafter to 12½%. Rentals are 25 cents per acre. The favorable terms which are available have been instrumental in stimulating interest in the area.

Much of the activity in the area has been by Havenstrite Oil Co., which has drilled two wells on its 60,000 acres across Cook Inlet, in the Iniskin peninsula area. The first well was drilled to 8,700 ft between 1936 and 1940. The second was on the Fitz Creek anticline, begun in 1954. It was suspended at 9,745 ft, and high gravity oil shows were found between 6,000 ft and 7,000 ft.

Another independent which is operating in the area is Alaska Oil and Gas Co., which with Anchorage Gas and Oil Co. and Alaska Gulf Oil Co. have also been active and three wells have been drilled by the companies north and northeast of Anchorage. The companies control 65,000 to 85,000 acres each in this area.

A major shot in the arm for oil and gas development in Alaska is expected once the USA takes action to open up some 20 million acres near Naval Petroleum Reserve No. 4. The Navy, Alaskans, and private companies have said they want the action. At present, and for some time, the decision has been up to the Secretary of the Interior. Secretary Seaton, however, wants the approval of Congress before taking any action.

Public Land Order 82, a wartime measure signed January 22, 1943, withdrew three separate areas from entry under the public-land laws. These tracts were located on the Alaska peninsula, the Gulf of Alaska, and the Arctic slope. In 1946, the lands on the Alaskan peninsula and the Gulf of Alaska were opened, and oil and gas prospecting is now being carried on in both areas by private firms.

The Arctic slope withdrawal in northern Alaska totaled 48.4 million acres, including about 28 million acres in Naval Petroleum Reserve No. 4 which would not be affected by the proposed land opening.

The Department of the Navy has advised Interior that it would raise no objection to revoking PLO 82, provided the revocation did not affect the present status of the lands in the naval reserve.

"Additionally," Interior said, "it is understood that the Department of Defense to recommend that certain other lands within the area covered by PLO 82 be reserved for defense purposes."

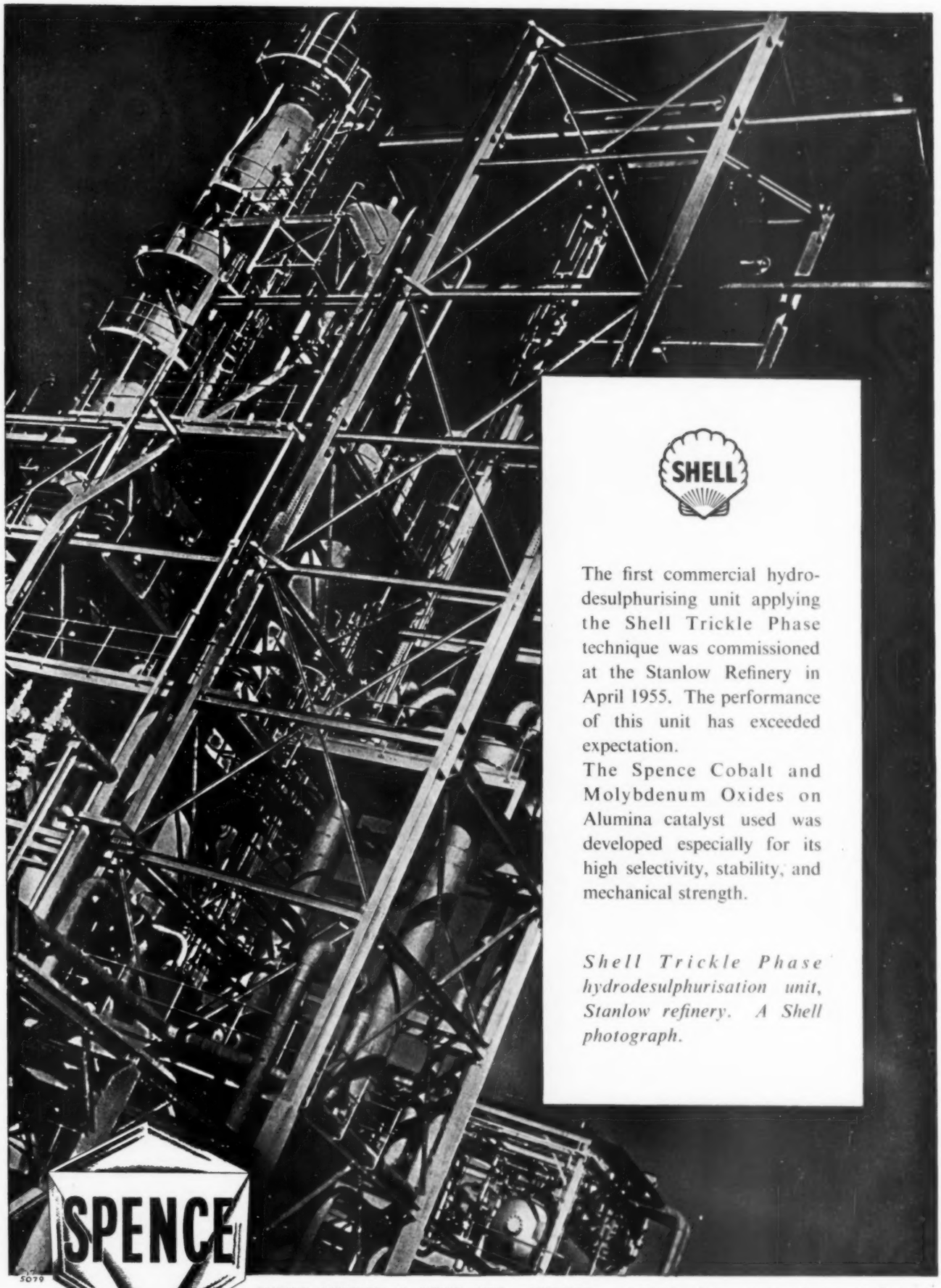
If PLO 82 is revoked, Departments of Interior and the Navy will coordinate the disposal of naval oil-well drilling equipment, declared surplus when the naval exploration program was suspended, with any mineral leasing in the area.

Latest word from Secretary Seaton is that a decision should be made promptly, and that he expects one bofer the present session of the US Congress—expected in July.

France

Progressive development of the Parentis discovery brought French production up to 28,900 b/d at the end of 1956, making a sizable contribution toward meeting the Suez crisis. Stimulated by the Parentis discovery, a number of companies have applied for concessions.

Several applications for exploration concessions in southeastern France have been made to cover areas for which the Societe Nationale des Petroles d'Aquitaine holds concessions, and which are due to be given up on October 3, 1957. They include Universal Neptune Co., seeking a 5-year permit over an area of 2,500 square kilometers in the Landes and Basses-Pyrennees Departments; SA Francaise de Recherches et d'Exploitation de Petrole (SAFREP), seeking two 5-year permits over 360 and 2,300 square kilometers in the Landes Basses-Pyrennees and Gers Department; Mobil Oil and Recherches et Exploitation de Petrole et de Gaz, applying for a joint 3-year permit over 5,404 square kilometers in the Gers and Landes Departments; Regie Autonome des Petroles, a 5-year permit over 4,431 square kilometers in the Gers,



SHELL

The first commercial hydro-desulphurising unit applying the Shell Trickle Phase technique was commissioned at the Stanlow Refinery in April 1955. The performance of this unit has exceeded expectation.

The Spence Cobalt and Molybdenum Oxides on Alumina catalyst used was developed especially for its high selectivity, stability, and mechanical strength.

Shell Trickle Phase hydrodesulphurisation unit, Stanlow refinery. A Shell photograph.

SPENCE

PETER SPENCE & SONS LTD · WIDNES · LANCS Also at London and Bristol

Hautes-Pyrennees, Landes, and Lot-et-Garonne Departments; Societe des Petroles de Valence, a 5-year permit over 1,618 square kilometers in the Landes, Gironde, and Basses-Pyrennees Departments; Societe de Prospection et d'Exploitation Petroliers en Alsace (PREPA), seeking a 5-year permit over 3,367 square kilometers in the Gers, Landes, Basses-Pyrennees and Haute-Pyrenees Departments; Esso REP, applying for a 5-year permit over 2,517 square kilometers in the Gers, Landes, Basses and Hautes Pyrennees Departments; and Compagnie Francaise des Petroles, seeking a 5-year permit covering 986 square kilometers in the Landes Department.

Esso Standard recently assigned its Parentis permit to ESSOREP (Societe Esso de Recherches et d'Exploitation Petrolieres) in which it hold a major participation (89%), with BRP (10%) and FINAREP (Societe Financiere des Petroles) as partners. Another producing field may be indicated by ESSOREP from shows of about 30 b/d at 6,704 ft to 6,917 ft at Lucats No. 1 well. The first well began production at Lucats in December at about 99 b/d. The Lugos field, which started production in September 1956, produced 37,420 bbl during 1956, and the Mothes field yielded 115,024 bbl during 1956.

A new discovery was reported by Esso Standard during early 1957, at Argentyres in the Parentis area. An exploratory well reportedly found oil at about 4,800 ft. Shows were of a heavy oil with a high asphalt content. Some water was produced, and drilling is continuing.

The French government is completing its Lacq gas plans. The 6 completed wells in the Lacq gas field will provide about 35 million cubic feet daily, according to the Ste. Nationale des Petroles d'Aquitaine, as soon as the first portion of the processing plant is placed in operation.

The Cie. des Petroles de Guyenne, in which the Shell group has an interest, recently spudded its first test well in Dordogne Department, near Capanac-les-Quercy.

The French government has recently listed the companies which are eligible for financial aid through the government's petroleum fund. They are: Societe de Prospection et Exploitation Petrolieres en Alsace (PREPA), Compagnia d'Exploration Petroliere, Compagnie des Petroles de Guyenne, Compagnie Francaise des Petroles (Normandie), Societe des Petroles de Valence, Compagnie Francaise des Petroles (Gascogne), Compagnie des Petroles d'Algerie, Societe Petroliere de Recherches et d'Exploitation de Petrole, Societe Petroliere de Recherches dans la Region Parisienne, Societe de Recherches et d'Exploitation des Petroles en Tunisie, Societe des Petroles de Madagascar, Societe de Recherches et d'Exploitation des Petroles au Cameroun, Societe Africaine des Petroles, Societe des Petroles du Senegal, Societe Independante de Recherches et d'Exploitation de Petrole, and Societe France-Outre-Mer de Prospection Exploitations Petrolieres.

Several of these companies have foreign capital participation.

Austria

The principal private company exploring in Austria is Rohoel-Gewinnungs AG (RAG), owned 50-50 by Socony Mobil Oil Co. and the Shell group. RAG activities during 1956 were highlighted by the discovery of 84 b/d of 34 API crude at 7,750 ft in a 6-ft section in Puchkirchen No. 1, an exploratory well which hit basement at 8,500 ft in Upper Austria. Another wildcat was begun, October 19, at Geretsberg, south of Braunau at the German border.

As of May 1, 1956, a total of 15 concession applications over about 7,720 square miles had been received by the Federal Ministry from various companies.

The Austrial Oil Administration (OeMV) has undertaken a $14 million modernization plan to replace declining crude production levels caused by deterioration of the production equipment during the Soviet occupation. The largest share of the proposed expenditure is $5 million for 90 development wells; $1.4 million for 14 exploratory wells; $2.8 million for refinery improvement, and a pipeline from Bockfliess field to Korneuburg refinery; and $2.6 million for natural-gas facilities.

Germany

Among the oil finds during 1956 are those at Schwedeneck in Schleswig-Holstein; Eilte-West, Leiferde, Rietze, and Hoever in Hanover; Elsfleth, Oythe, Ortland, and Harme in the Weser-Ems district; and Landau, Huttenheim, and Minfeld in southern Germany.

Exploration in the Bavarian Molasse basin has up to now not justified hopes aroused when the first finds were made east of Munich at Ampfing and Isen. Also, in the upper Rhine valley Graben, wildcatting is not showing very encouraging results. Chances of finding oil here are mostly limited to small heavily faulted block structures.

Oil companies now are considering northwest Germany and the older sediments of Permean, Carboniferous, and Devonian age which, at depths of more than 13,000 ft, lay below the huge Zechstein salt deposits. Thus far this pre-Salinarian has not yet been reached, because drilling in the very thick salt formation offers special difficulties.

Denmark

Oil possibilities in Denmark are believed to result from the extension of a large fault across the island of Bornholm, and some possible petroliferous structures are believed to lie parallel to the fault line. The drilling of over 33,000 shallow water wells has aided geological studies in the country, and has demonstrated the existence of shallow salt domes in North Jutland.

Among the likely source beds are the Lower Cretaceous, and the Senon chalk beds. These are based on similar producing zones in northern Germany. One test, the Tonder well, has had good oil shows at 10,150 ft. It was located about three miles north of the German border in South Jutland.

Exploration rights over the country have been held by the Danish-American Prospecting Co. since 1938. Danish-American was owned by Gulf Oil Corp. until recently. During 1956 it was announced that the company would transfer its concession to Standard Oil Co. (N.J.).

Standard plans to invest about 35 million crowns in exploration, according to press reports, at the rate of about 7 millions yearly. The concession covers the entire country, and expires in 1960. Gulf drilled 3 deep tests below 10,000 ft to the Permian, but had little success. Early in 1956 core drilling to about 600 ft was being done on Sjaeland Island. The country has a very favorable oil law.

Sweden

There has been little exploration in Sweden, and a recent exploratory well, Ljunghusen No. 1, was drilled in southwest Sweden. It was unsuccessful. The well went to 7,480 ft, where it stopped in Silurian shale. Small gas shows were obtained during drilling of the Muschelkalk (Middle Triassic) between 4,275 ft and 6,800 ft.

Italy

The major event in Italian exploration was the final passage of the long-debated oil law. The law in its final form provided for royalties payable on a per-well basis up to 22%; and this, together with some other aspects of the law, caused Gulf Oil Corp. to surrender its holdings in the Abruzzi area and retire from the country. Gulf remains in Sicily, however, which is a province of Italy with autonomous status and which has a separate oil law.

Recently the government passed a special oil law regulating activities in the continental shelf of Italy —with considerably more favorable terms than the mainland law.

Concessions in Sicily have been granted by the region's authorities to the following companies: Edison and subsidiaries, 314,636 hectares; Montecatini-Gulf, 258,247 hectares; Ente Nazionale Idrocarburi, 361,162 hectares; Rasiom-ESSO, 74,134 hectares. The whole area granted in 1956 to the above and other Italian and foreign companies covered 1,350,178 hectares.

Spain

Exploration in Spain has been retarded by a requirement that foreign participation in companies be limited to 25%, with exceptions made up to 49% ownership. Recently the government was reported to be considering relaxing this provision to allow foreign companies to own the majority of the company and to install the 50-50 profits split concept. General Franco is reported to be personally directing a study of the shift. Since 1952 the government has preempted all concession areas except those previously granted. Presumably these would be released, under a major new change in policy. Herbert Hoover Jr. is advising the government on oil matters. At present some exploration is being conducted by a group of American companies.

Portugal

The entire area of continental Portugal is covered by an exploration concession held by the Companhia dos Petroleos de Portugal (CPP), owned on an almost equal basis by the Portuguese government and by Axel Johnson interests, of Sweden. A small number of CPP shares is owned by other private stockholders.

CPP has signed an operating agreement with Exploration Co. of Portugal Inc., owned by Socony Mobil Oil Co., under which Socony got a participating interest in the concession which it is presently exploring jointly with CPP.

The principal area of interest is Torres Vedras, located a few miles north of Lisbon. Pinhal Novo No. 1, an exploratory well about 12 miles east of Lisbon, recently went to 5,497 ft, where it reportedly encountered the Miocene resting on the Triassic in a diapiric structure. Another well, Arruda No. 1, 18 miles north of Lisbon, has been drilled below 6,000 ft, and 5 shallow tests have been drilled in the Torres Vedras area. Some encouraging oil and gas shows have been reported.

Middle East

Turkey

Turkey's first exploratory well by foreign investors is drilling below 6,000 ft on the shore of the Mediterranean. The well is being drilled on a farmout from Gilliland Oil Co., of Los Angeles. It is located in the Adana basin of the Iskenderun Gulf area. There are two known structures in Gilliland's exploration areas, one known as the Rubaikale structure near the border of Iraq. The other is on the coast, and is an anticlinal structure lying partly offshore.

American Overseas Petroleum Ltd., a Caltex affiliate, will drill a wildcat about 18.6 miles from Gaziantep in southern Turkey this year.

Among the companies now in Turkey are Esso Standard (Turkey) Inc.; Bataafsche Petroleum Maatschappij, of the Shell group; Feldman Oil and Gas Inc.; Turkish National Oil Co.; Mobil Exploration Mediterranean; Gilliland Oil Corp.; Bolsa Chica Oil Co.; Istanbul Natural Gas Co.; the Istanbul Elektrik ve Gas; the Turkiye Petrolleri AO; Husky Oil Corp., a US independent; C. Deilmann Montan GmbH; and American Overseas Petroleum Ltd.

Husky Oil Co. has transferred its exploration rights to Marmora Petroleum Corp., a subsidiary; and Mobil Oil Turk AO has transferred its licenses to Mobil Exploration Mediterranean.

Syria

A discovery has been reported on the exploration concession which was obtained, May 16, 1955, by James W. Menhall, owner of the J. W. Menhall Drilling Co., of Benton, Ill. Area originally covered was 28 tracts, of 300 km each, scattered through the northern part of the country. His first well reported commercial shows of 20 gravity oil at 6,640 ft in October 1956. It was later reported producing 1,500 b/d to 2,000 b/d. It is known as Caratchok Dagh No. 1, located in the northeastern tip of Syria at Caratchok Dagh, about 2 miles from the Tigris River and near the Turkish border. Recently a new test, a mile from this discovery, has been spudded. A syndicate headed by Cyrus S. Eaton, chairman of Chesapeake and Ohio R.R., reportedly put up $200,000 in exchange for one-third interest in the Menhall company.

A total of 49 exploration permits, covering 5,791 square miles, has been given to Ste. des Petroles Concordia-Damascus, associated with Deutsche Erdoel Co., of Hamburg, Germany. The company

It's the *APPLICATION* of Cathodic Protection that matters...

...AND THAT'S WHERE EXPERIENCE COUNTS

Hughes' "Guardion" Technique of cathodic protection is based on long term experience which cannot be equalled by any other company.

Consider the facts:—

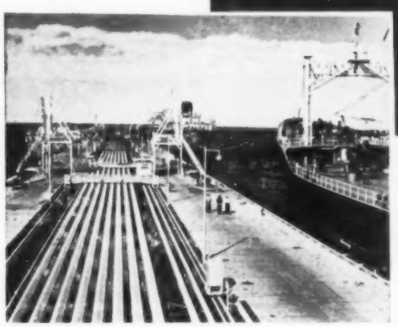
F. A. Hughes were the first Company to establish a specialised cathodic protection service in this country.

Hughes' "Guardion" Systems or equipment, both "Impressed Current" and "Galvanic" have since been employed on more than 1,500 installations in the United Kingdom and abroad.

Hughes' "Guardion" Service is comprehensive and is fully equipped for consultation, site investigation, supply of equipment, installation supervision and commissioning.

"Guardion" Cathodic Protection is applicable to pipelines, refinery and other specialised plant, sheet steel piling, ships' hulls and cargo/ballast compartments.

Write for details to:—



Kuwait Jetty at Mina-al-Ahmadi which was protected by "Guardion" Galvanic Anodes.

F.A. HUGHES & CO. LTD.

GUARDION

Cathodic Protection Division,

DEVONSHIRE HOUSE, MAYFAIR PLACE, PICCADILLY, LONDON, W.1.

Telephone: MAYfair 8867 Telegrams: DISTANCING PICCY, LONDON

will start several wells in the near future. It plans to spend some $5 million on exploration in next 3 years.

Israel

Operations in the Heletz field are being stepped up because of the difficulty in obtaining enough foreign oil since the Suez closing. Lapidoth-Israel Petroleum Co. Ltd. has rented rigs from other operators to supplement its own group of five rigs which have been working in this field. Latest reports say that 12 rigs were working.

The Heletz field was discovered by Lapidoth in September 1955, when it deepened an old well abandoned by Iraq Petroleum Co. at the time it gave up its Israel concession. At the end of 1956 five wells were flowing and four shut in. Output was averaging 700 b/d.

Since the shortage developed, Lapidoth has increased the size of chokes on its wells and opened more to production—bringing current output above 2,000 b/d. The field now appears to be larger than originally thought, and a 66-well program is envisaged. Wells follow an 80-acre spacing pattern.

The Israeli government is considering formation of a national oil company according to an announcement in parliament by Mordechai Ben-Tov, minister for development. He stated that 10 wildcats will be drilled this year in various parts of the country. Surveys are in progress for a deep sea oil port at Elath on the Red Sea.

Jordan

An exploration concession application by a Guatemalan businessman, Jorge Zimeri, has been rejected by the government of Jordan, according to reports. Mr. Zimeri had requested a concession over one-third of the country through the Peguasa Oil Co., in Guatemala.

Edwin W. Pauley, California independent oil operator, obtained a permit granting him the right to select one-third of the country by October 1957 for concession. The contract was effective February 2, 1956, and is divided into 2 areas. Duration is 55 years, if production is obtained. Drilling obligation was 20,000 ft per year on each of the 2 properties. A cash payment of $50,000 was made, to be followed by $50,000 each year during the following 2 years—rising to $100,000 in the third year and $200,000 yearly thereafter. Royalty is 16 2/3%. The 50-50 profits split is to go into effect if production is found.

The Pauley company was forced to pull its personnel out of the country during the recent Mid-East crisis, but has since re-entered. Robert Ray Co., of Houston, is conducting gravity and magnetometer work for the company. Press reports have indicated the Pauley concession area is in north-central Jordan, north of latitude 30° 45′ north, including the northwestern part of eastern Jordan around the Irbid area, extending south to the capital city of Ammann, but not including the shallow southern part of the Dead Sea and the area immediately east and south of it.

Lebanon

The principal petroleum concession in Lebanon is held by Cie. Libanaise des Petroles, a French-Lebanese group. The company is the successor to Cie. Libanaise, a local firm which drilled a well at Yohmore, in the southern Bakaa plain, in association with Pacific Western Oil Corp. (now Getty Oil Co.). A. S. Onassis, tanker owner, is now reported to have made a substantial investment in the company.

Iraq

Exploration in Iraq has been slowed down in recent months by the Suez crisis, according to the director general of Iraqi oil affairs. Five teams of the Basra Oil Co. are prospecting for oil in the southern area. One team was working in an area 70 km southwest of Karbala; two teams west of Samawa; a fourth team in the southern desert, west of El-Shabaka; and a fifth east of Shattal. Two are prospecting in an area covered by the concession granted to the Mosul Oil Co. in Ain Kattan near Mosul, and in the El-Dalim district. In the Balkhana area oil may have been discovered.

Kuwait

Early in 1956 the Ruler of Kuwait invited bids on offshore concession grants. There has been no further announcement on this, and some observers believe that action will be delayed until the Suez crisis is solved.

Kuwait Oil Co. has been drilling two wildcats in recent months. Following completion of Raudhatain No. 2 early last year, the rig was moved 10 miles southeast to a new exploratory location, Sabriya No. 1. The second test recently drilling was at Bahra, 12 miles southeast of Sabriya.

ROTARY DRILLING RIGS ACTIVE

Country	Number of Rigs Aug. 1, 1956	Feb. 1, 1957
Western Hemisphere		
Alaska	4	5
Argentina	67	68
Bolivia	11	12
Brazil	28	29
British Honduras	1	0
Canada (Western)	247	238
Chile	6	6
Costa Rica	1	1
Cuba	11	9
Colombia	20	23
Ecuador	9	9
Haiti	1	1
Jamaica	1	1
Mexico	95	95
Peru	20	21
Trinidad	27	27
United States	2,536	2,264
Uruguay	1	1
Venezuela	128	129
TOTAL WESTERN HEMISPHERE	3,224	2,939
Eastern Hemisphere		
Algeria	15	18
Angola	2	2
Australia	13	3
Austria	15	15
Bahrain	3	3
British Borneo	9	8
British Isles	9	8
Burma	4	6
Egypt	8	2
Ethiopia	1	1
France	29	28
French Equatorial Africa	9	8
French Morocco	8	6
Germany (West)	106	105
Greece	3	1
India	4	8
Indonesia	22	23
Iran	5	10
Iraq	10	10
Israel	16	12
Italian Somaliland	1	1
Italy	15	15
Japan	15	15
Kuwait	5	6
Madagascar	1	2
Netherlands	9e	4
New Guinea	4	3
Nigeria	1	6
Pakistan	7	10
Papua	3	3
Portugal	2	3
Qatar	7	6
Saudi Arabia	12	12
Sicily	35	38
Spain	3	3
Tunisia	5	2
Turkey	5	7
Yugoslavia	26	26
Zanzibar	1	1
TOTAL EASTERN HEMISPHERE	358	445
WORLD TOTAL	3,582	3,384

eEstimated

END

Saudi Arabia

A major exploratory discovery was made in Saudi Arabia during 1956. During June, Arabian American Oil Co. announced a discovery at Kharsaniya No. 1, an exploratory well located 80 miles northwest of Dhahran. The well was completed as a producer in the "D" member sand of the Arab zone, although potential production was developed in the "A", "B", and "C" members as well. Some oil in lesser amounts was found in the middle Jubaila zone; none was found in the Hadriyah or Fadhili zones. A second well is now drilling about 4 miles north, designated Kharsaniya No. 2.

In addition to these wells, Aramco has continued with three structural drilling parties—three seismic, one gravity-magnetic, and one surface-mapping party. Work in the Rub al Khali established the presence of a separate Tertiary basin, which may indicate the Jurassic trend, but does not extend far south of Ghawar field.

The government began an aerial photographic survey in 1956 of 200,000 square miles in the eastern part. Aramco did a similar survey over the southern Rub al Khali in 1955. A seismic party operated in the gravel plains during the first half of 1956, and another operated for a month offshore in the Persian Gulf.

Six drilling rigs are currently active. One well has been completed in Ghawar, and two in Safaniya—of which one went to 13,297 ft, more than 7,000 ft below the field's producing Cretaceous zone.

Iran

During the spring of 1956 the Shah of Iran indicated in a speech that exploration rights outside the consortium area might be granted. Such rights would have to be within the framework of the Nationalization Law of 1951, and could only be obtained through contract with National Iranian Oil Co. (NIOC), as that company was established by the 1951 law. A number of companies are now negotiating for exploration rights over both onshore and offshore areas—including ENI, owned by the Italian government. During mid-February the government was considering bids from various companies, including several independent groups.

Plans for development of the Qum discovery have not been announced by NIOC. It is understood that the next well to be sunk will be drilled directionally to relieve the discovery which flowed wild and finally killed itself. At its peak, Qum No. 8 was blowing about 50,000 b/d into the air.

Aden Colony

The BP subsidiary, D'Arcy Exploration Co., has obtained an oil exploration license covering the British group of Kamaran Islands and their territorial waters. This group of islands lies off the coast of Yemen, in the southern part of the Red Sea, and is administered by the government of Aden. Kamaran, the main island, has an area of about 22 square miles. In the very near future, geological gravity and magnetic surveys are planned to commence over the land areas.

Asia and Australia

India

Standard-Vacuum Oil Co. has carried out an aerial survey of the Bengal basin area of India and East Pakistan.

This company has a concession for exploration of about 10,000 square miles. An exploratory well is planned in the Bengal basin, this year.

The Indian government recently received the aid of a team of Russian oil advisers. Two Russian drilling rigs, plus one Romanian rig, with the services of 88 technicians for six months to train Indian personnel, were included.

The team of Russian advisers outlined an extensive program of exploration for the Indian government's 5-year plan. It included 34 deep exploratory wells during the 5-year period, with a total footage of 464,500 ft, plus a start on six more wells; 17,250 miles of seismic profile shooting; and drilling of 145 shallow tests with a total footage of 500,000. Exploration was recommended in the Punjab and Rajasthan basins, with a survey and core-drilling work in the Cambay region of western India and on the Madras coast; deep exploratory drilling in the Ganges valley of West Bengal; more exploratory drilling in 5 Punjab areas and in Rajasthan; and setting up 14 gravity, 10 seismic, and 15 geological parties, and 10 drilling crews.

An exploration team under the charge of a Russian expert is now surveying the Jawalmukhi range, and has marked a location near the village of Pathiar in the Kangra tehsil. The Central Public Works Department has started terracing and widening the approaches to the spot so that heavy machinery can reach there when a regular survey begins.

Meanwhile exploration in Jawalmukhi in the hilly regions of the Punjab has been extended to the plains around Hoshiarpur.

India's search for oil will soon be extended to the west coast in Kerala and at Cambay, near Bombay—this time with the help of German experts. Three West German oil experts—Dr. Hans Closs, Dr. Schott, and Dr. Richterbernburg—have left for Calcutta for consultations with the Geological Survey of India. After a brief visit to Assam, they will leave for a geophysical survey.

Private USA and Canadian companies have shown interest in Indian exploration, according to

SATURDAY, AUGUST 25, 1956.

SALAM

THE STAFF WEEKLY NEWSPAPER AND OFFICIAL NOTICES OF THE BRITISH MALAYAN PETROLEUM COMPANY LTD. AND SARAWAK OILFIELDS LTD.

NEW SHIFT TEAMS WILL RUN LUTONG REFINERY

A reorganisation of staff responsibilities took place last Monday at Lutong Refinery, designed to streamline supervision of the refinery's expanding operations.

Seven Labour workers in the refinery have been promoted to Regional Staff: Peter Mayor and Amit bin Samat (Distillation Assistant Foremen), Liew Kok Thong and [illegible] Chundi (Laboratory Assistants), [illegible] Kim [illegible] and Aman bin Salleh (Installation Assistant Foremen), Trokie bin Jaludin (Local [illegible] Assistant Foreman).

All routine refinery operations are now [illegible] series of Shift Teams, each comprised of a Supervisor, a Foreman, and three Assistant Foremen — Distillation, Installation and [illegible].

As from September, it is planned to transfer the Oil Accounts Section to the refinery, where it will work under the Refinery Technologist and the Senior Installation Supervisor. From that date an Oil Accounts [illegible] join each Shift Team. Thereafter, these Shift Teams will be responsible for all the refinery operations, [illegible] receipts, distillation runs, tank farm movements, ships, laboratory testing and oil accounting. The [illegible] work together in the same shift cycle and will thus keep together as a team.

By grouping all routine activities under the Shift Team, Technologists and Section Heads will have more time to concentrate on programming, future planning, and the efficient administration of their sections.

[illegible] is the growing operations of the Refinery. [illegible] two years ago [illegible] the present figures, Seria's Gas Plant was [illegible] of the future, and therefore no [illegible] was being [illegible] and no [illegible] produced. Furthermore, the old sea-loading pump station [illegible] and relatively [illegible] Lutong.

To-day, the Refinery deals with 'spiked' naphtha, two grades of [illegible] an extra grade, and faster [illegible] ing of much larger [illegible] with night-bert[illegible] [illegible] programming is closely [illegible] with Singapore, Pladju, Geelong and Clyde — more [illegible] and closer co-ordination.

Parallel with these advances, [illegible] the necessity to step up efficiency, and increase the study of economics, pollution and waste problems.

These expanding activities have meant more work for the Section Heads and Technologists and the new reorganisation is designed to free them from the routine day-to-day operations.

WELL DRILLED IN NINE DAYS

Well 439 in the Labour housing area has been the fastest-drilled medium-depth vertical hole in the Seria Field to date.

The number of days from spudding-in to reaching the final depth of 5576' was just over nine days. Well 423 reached this depth 10½ days after spudding-in, and Well 405 took 11 days.

A new type of bit was used for the first time in the area—a long-toothed Security S3J tricone jet bit.

Well 439 is a vertical well, and the average net rate of penetration in 9⅞" hole (i.e. after setting 10¾" casing) was 67.4 ft/hour, from 1505 feet to 5107 feet, compared with 64 ft./hour over the same interval in the previous fastest well, No. 423.

Five bits were used to drill from 1505' to 5556' — an average of 810'.

The drillers were: A.A. Ahmed Assan, M. Krishnan, K. R. Govindan, Jamal Mohd. (relief driller).

Dick—
It looks like
Security Bits are
setting all kinds
of records. Better
run them on
your next well.
JCM

Pili[illegible]
of Jacke[illegible]
carrying [illegible]
average [illegible]
was 4 - 4
It [illegible]
Jackets w[illegible]
complete[illegible]
The [illegible]
struction [illegible]
Location [illegible]

PEN
FOR

Peng[illegible]
Supervisc[illegible]
United K[illegible]
Peng[illegible]
sory Cou[illegible]
on Educ[illegible]
Council.
served co[illegible]
Regional[illegible]
In th[illegible]
Peng. Ba[illegible]
Advisers[illegible]
attend a[illegible]
by them,[illegible]
visit will[illegible]
tunity to[illegible]
lations [illegible]
London;[illegible]

the government, which announced recently that Schlumberger Well Surveying Corp. would be commissioned to conduct seismic and gravity surveys in Rajasthan.

Reserve estimates at Nahorkatiya have recently been revised upward. The chief geologist of Assam Oil Co., W. B. Metre, recently stated that the field is capable of producing 2,500,000 tons yearly (about 50,000 b/d of crude, plus 45,000 mcf of gas for the next 20 years.

A local company, Birla Bros., has made application for a concession covering primarily the desert areas in the northwestern state of Rajasthan. The application is under study by the government.

Standard Vacuum plans a deep test in East Pakistan during 1957, its first exploratory well in the eastern part of the country. A third wildcat is also planned in West Pakiston. The company is now drilling on No. 1 Mari, begun during December, and located about 200 miles north of No. 1 Digh, abandoned at 10,900 ft. in the Indus River valley above Karachi during 1956.

Pakistan

Standard Vacuum holds concessions in both the West Pakistan basin and the Bengal basin of East Pakistan, totaling about 20,000 square miles. The company is drilling 200 miles north of Jhudo where the first West Pakistan wildcat was a failure. A seismic crew has operated in the area, and an air magnetometer survey has been done on 120,000 square miles of West Pakistan on about 30- to 50-mile spacing, followed by a gravity survey with 2 parties. First East Pakistan well will be drilled this year.

The N.B. Hunt interests, of Dallas, have a concession along the coast of the Arabian Sea, west of Karachi toward the border of Iran and along the Indus River valley north of Karachi.

On May 26, 1956 an agreement was signed with Shell of Pakistan Ltd., covering exploration of about 10,000 square miles in West Pakistan and an equal amouunt in East Pakistan. Petroleum Development of Pakistan Ltd. will be wholly owned by private Pakistan capital, and will hold 25% of the shares in the new company.

Pakistan Petroleum has scheduled two deep tests, and will complete during 1957 three wells now drilling. One test is to be drilled at Bannh, West Pakistan, 50 miles southwest of Sibi, northwest of the Sui gas field. The other will be drilled at Lalmai, near Comilla, close to the Burmese border in East Pakistan.

Pakistan Petroleum Ltd. recently discovered a new major gas field, the third after Sui and Uch, at Sylhet (East Pakistan) when gas in commercial quantities and at high pressure was struck at a depth of about 8,000 ft in Sylhet No. 2 well.

Burma

Operations during 1956 were confined to development drilling and reconditioning of wells in the Chauk and Lanywa fields of central Burma, with a view to building up the field potential. It is expected that eventually the oil fields of central Burma may be able to produce about 10,000 bbl of crude oil per day. Prewar production from these fields averaged 21,500 b/d.

Burma Oil Co. (1954) Ltd. recently announced it will drill the first wildcat in Burma since before World War II, after extensive preliminary work, including the construction of an approach road and a camp. The well, which may go to 10,000 ft, will be located in Magwe district on the Ondwe structure, a well-developed dome on the same axis of uplift as Yenangyaung field about 30 miles northwest. The horizons which are productive in Yenangyaung are expected to be found at a much greater depth in a new test.

Indonesia

Pending passage of the new petroleum law in Indonesia, exploration rights are in moratorium—which restricts companies to present acreage, since no new areas are being granted, despite the country's excellent oil potential. Although no new finds have been officially reported, the companies are carrying out exploration on their existing concession areas; and recently Caltex, one of the three principal operating companies, is reported to have made a discovery. The company made the major post-World War II find in Indonesia at Minas.

Exploration prospects in Indonesia could be encouraging, and offshore prospects appear particularly so. Marine waters in the South China Sea are generally shallow, and operations could be carried out in large offshore areas off Sumatra, Borneo, and Java.

A special committee has been set up under the chairmanship of Vice Premier Mohammed Roem to study the return of Shell's concessions. Government spokesmen have not confirmed the report that an understanding had been reached with Shell, and the report was denied by the company.

Philippines

At present there are seven exploring companies in the Philippines. Caltex (Philippines) is jointly owned by The Texas Co. and Standard Oil Co. of California, both of which have separately acquired substantial concessions. Standard Vacuum Oil Co. has planned an exploratory well in 1957. An independent American company, San Jose Oil, also holds concessions.

Two other exploring companies are backed by local Philippine capital. Philippine Oil Development Co. (Phodco), owned by Andres Soriano, initiated drilling operations (in which Caltex has a 50% interest) during October 1955 in the Cagayan valley of northern Luzon island. Under its former name of Far East Oil Co., it drilled two wells previously in the Daan-Bantayan area.

The well by Phodco, Tumauini No. 1, is located on the Tumauini anticline. It found shows of oil at 3,690 ft and 4,000 ft, and further down encountered considerable quantities of natural gas. However, it was considered off-structure, and abandoned at 10,414 ft. A second well was scheduled by Phodco, about 3 miles west, during 1957.

Papua

At present there are three companies exploring in Papua, viz., Island Exploration Co., Australasian Petroleum Co. Pty. Ltd., and Papuan Apinaipi Petroleum Co., an independent company which holds an exploration concession in the Philippines covering some 8,600 square miles northwest of Port Moresby. To date no oil discoveries have resulted from the efforts of any of these companies.

The most active company in exploration is Australasian Petroleum, which has drilled a series of wells and conducted an active exploratory campaign in southwestern Papua.

Kuru No. 2, a wildcat by Australasian Pty. Ltd., cemented casing to 563 ft in July 1956. This well is a replacement for Kuru No. 1, which had a gas blowout at 998 ft. Another rig was set up at Barikewa, near Kuru, during mid-August 1956.

Australasian Petroleum Co. Pty. Ltd., and Island Exploration Co. Pty. Ltd., have reported that it should be possible to start drilling Kornewu No. 1, Papua, by mid-April 1957. Kuru No. 2 has been deepened 592 ft to 5,838 ft, progress having been slowed up by difficult formation conditions. At Barikewa depth is still 1,591 ft, the entire effort during the past month having been devoted to sealing upper cavernous formation. Morehead was deepened 2,876 ft, to 7,782 ft.

Japan

In 1956 seismic activity in Japan continued to increase, especially along the Kanto plains, where Tokyo is situated, and in the mountains. The one outstanding discovery is located at Daihango in Akita prefecture. It produced about 7 b/d from 1,640 ft.

During 1956 Teikoku Oil Co. began deep drilling with a rig capable of testing formations below 12,000 ft. It may also be used offshore, where offshore seismic work by the government's Petroleum Resources Development Council is reported to have located five structures off Akita prefecture, in northern Honshu.

A discovery was reported in Niigata prefecture by Japan Petroleum Exploration Co. Located at Kawaguchi, at Kita-Uonumagun in Niigata, it produced 13 kiloliters (about 80 b/d) during November 1956. Drilling is continuing, with another discovery reported at Hokkaido, Japan's northernmost main island.

An elaborate program of the Petroleum Resources Development Council for future development of local Japanese crude supplies calls for an increase in output to more than 17,000 b/d—almost 3 times the actual current rate. This is to be accomplished by some increase in production from present fields, additional application of secondary recovery, and output of some 8,000 b/d from new discoveries.

Under-seas coastal coal and oil will be surveyed in 1957 by government geologists.

Oil Resources Development Council recently announced a discovery in Niigata prefecture (state). The new well at Kawaguchi reportedly produced 13 kiloliters (91 bbl)per day. The company is also drilling at Hokkaido and Akita prefectures—with discoveries reported recently in Hokkaido, the northernmost main island.

British Borneo

During 1956 British Malayan, which already had been operating four platforms offshore from the Seria field, added three more, and plans to add five during 1957. They are all on extensions of the Seria

Once the location is made it becomes necessary for the dozers to cut a road through jungle and hills to bring in the drilling rig. Pictured is an operation in the Velasquez field in Colombia. Photo courtesy The Texas Co.

hand-cranked

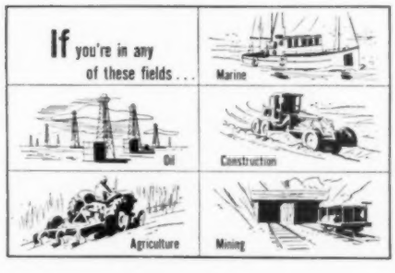
Bendix AE **INERTIA STARTER**

NO BATTERIES - NO CABLES - NO PUMPS - NO PLUMBING - ONLY A HAND CRANK

Your Engine-starting Troubles ELIMINATED

The Bendix Inertia Starter is a rugged, simple and dependable starting device which can be fitted to most engines. It is a complete self-contained unit for cranking your engine wherever it is, whenever you need it.

Unaffected by climate, vibration or other conditions of service. Simple to install. Simple to operate. Cranking can be extended to side, front or above engines by use of extension shafts, couplings and universal joints.



For Installations Where

- A rugged, simple and dependable starting device is essential
- Battery maintenance is a problem
- Shock conditions cause maladjustment of voltage regulation
- Shock conditions are damaging to electric storage batteries
- There is a fire hazard
- There is limited mounting space

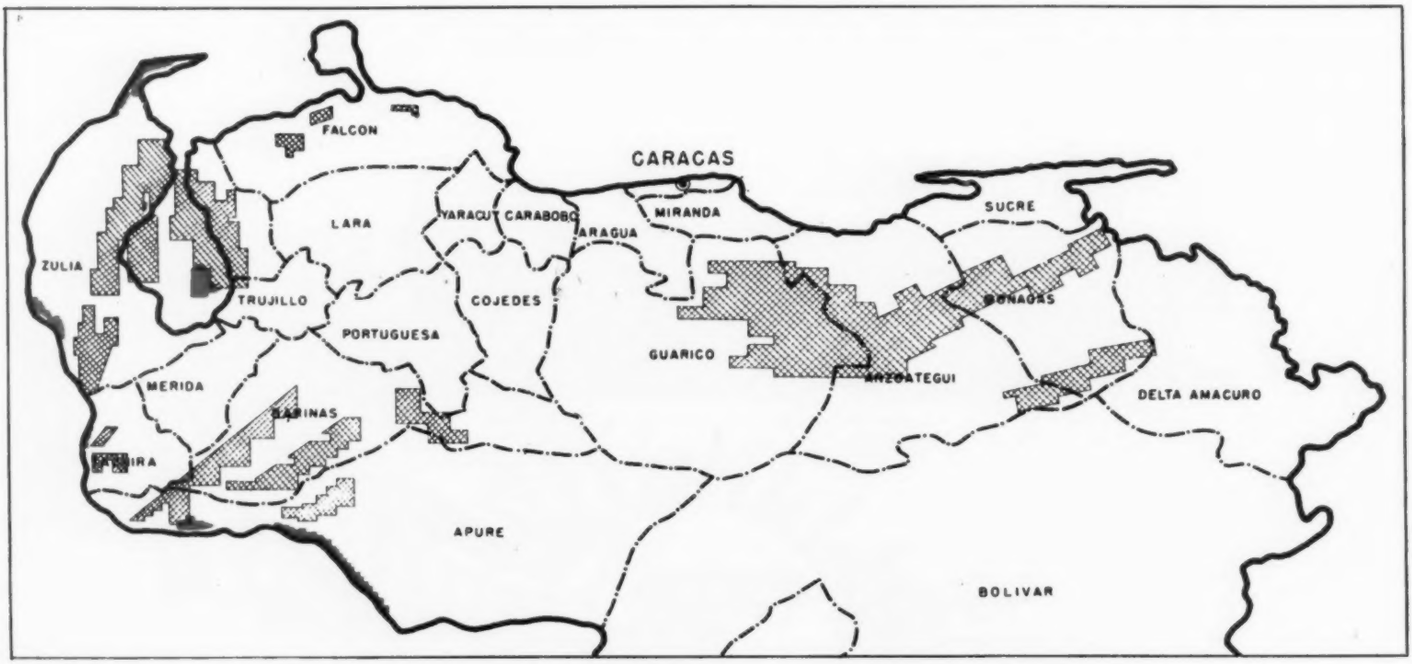
Write for full particulars to

AIR PUMPS LIMITED

Sales Dept: 8, FRANCIS STREET, WESTMINSTER, LONDON, S.W.1.

Phone: VICTORIA 5878/9. Cables: AIRPUMPS, SOWEST, LONDON.

Distributors of Bendix AE INERTIA STARTER for Bendix International.



Exploration concessions granted in Venezuela during late 1956 were predominately in the Lake Maracaibo and border areas, as shown in the above map. A second round of concessions and applications therefore are being processed at present. The border concessions granted to Venezuelan Independent American Oil Producers Association and to Star Oil Co. were voided for non-payment.

field, which has been declining onshore. The fifth rig was positioned about two miles to sea, slightly to the east of the Seria field, during October. Crew changes are being carried out by British-built Westland Whirlwind helicopters.

Another offshore rig was launched in 1956 at Ampa Patches, about 30 miles from Seria and 25 miles offshore. Sarawak Oilfields has a similar offshore platform at Siwa, 18 miles from Miri field.

New Zealand

Leading the field in exploratory work now is the Shell-D'Arcy-Todd concession over 5,574 square miles of the Taranaki and Rangitikei districts. Operations in this area began a year ago, and in the next year will be concentrated on the selection of the most likely drilling spots. In 1958 the organization expects to be in a position to select the best drilling area and to begin drilling.

Current oil exploration concessions in New Zealand total 19,563 square miles, most of the areas being in the North Island. The three major oil explorers in the field are the Shell Co., British Petroleum, and Todd Bros.

On the west coast of the North Island, in the Taranaki-Rangitikei concession, all three major companies are linked in the Shell-D'Arcy-Todd organization, the exploratory work for which is being carried out largely by Shell.

The North Island concession, the largest in New Zealand, is on the east coast, where British Petroleum is working in association with Todd Bros. over an area of 12,486 square miles. In addition, Todd Bros. itself has an area of 453 square miles on the east coast around Ruatoria.

From the Bay of Plenty northwards there are seven or eight other smaller concessions over areas of the West Coast and North Canterbury, again held by Todd Bros.

Active oil exploration work is proceeding both in Todd's North Island concession and its West Coast area. The largest known oil seepage in New Zealand occurred in the West Coast area, and gravity meter work carried out by the geological survey of the Department of Scientific and Industrial Research has disclosed some interesting new possibilities. Further geological work is now being undertaken.

In the area around Ruatoria, field work has consisted principally of mapping and geology interpretation of the rock formations. A paleontological laboratory had been set up to work in conjunction with field geologists. A magnetic survey of the area is also in progress.

Extensive seeps and showings of gas and oil occur in this area.

Preparatory work is under way for the start of exploration on the major concession on the east coast where BP is working in association with Todd Bros.

British Petroleum Co.'s preliminary work for the exploration included a photogeological survey which was being carried out in London. The company purchased aerial photographs of the concession from the government, and these are now under examination.

Geologists from areas of Canada, Papua, and Sicily—where BP already was proceeding with oil exploration—have assembled in New Zealand, and actual exploration began in January.

In the Taranaki-Rangitikei concession reasonable progress has been made in the past year's operations. Two geological parties had been operating through the area in 1956, and magnetic and gravity surveys had been completed. A seismic survey is now being carried out.

Drilling history of the concession area showed 50 wells have been drilled since exploration work started in Taranaki in 1865. Four of the wells, although small in output, are producing.

Australia

Exploration in Australia is nearly at a standstill, following a series of dry holes drilled by Australian operators. Interest was originally aroused when a 500 b/d well was discovered during December 1953 by West Australian Petroleum Pty. Ltd. (referred to here as WAPET), owned 80% by Caltex and 20% by Ampol, an Australian company, near Exmouth Gulf in Western Australia on the Rough Range structure. Offset drilling was disappointing.

Seven additional tests were drilled in the vicinity of Rough Range No. 1 to test the Cretaceous sand, and all found it barren except for a twin to the No. 1 well.

Throughout 1956 geological, seismic, and gravity meter crews were working in the Perth, Carnarvon, Fitzroy, and Canning basins, with up to 10 parties in the field simultaneously. During 1956 there was drilling activity in the Carnarvon, Fitzroy, and Canning basins.

During the year a dozen structure holes were drilled on Dirk Hartog Island, together with eight in the Rough Range area and two on Cape Range at Exmouth Gulf. Both these Cape Range holes and one of those at Rough Range were carried down to test the Birdrong sandstone—without any oil signs.

Other 1956 drilling activity included the completion of Cape Range No. 2 well, at a Southern Hemisphere record depth of 15,170 ft; completion of a 10,144-ft test well in the Kimberleys at Fraser River; and the drilling of stratigraphic test bores at Roebuck Bay and Dampier Downs—the first drilling conducted in the Canning basin.

Altogether during 1956, Wapet rigs drilled some 55,000 ft of hole, bringing the total since drilling first commenced in September 1953, to a round figure of 160,000 ft.

Other companies have drilled a total of 15 dry holes, ranging from 3,200 ft to 10,000 ft in depth, across the country in Queensland. Santos Ltd., a small Australian prospecting company formed in 1954, considers that the Cambrian limestones in Australia have the greatest potential as source beds of importance, and has repeatedly found oil traces near Port Augusta in South Australia.

New money is to be raised early in 1957 in Australia for a new oil search company, Timor Oil Ltd., which has been registered with a nominal capital of £5 million. Oil Drilling Exploration Ltd. will be managers and drilling contractors for the exploration programme on Timor.

In Gippsland, Victoria, Westralian Oil is to begin drilling early in 1957, searching inland from the south Gippsland coast. Woodside (Lakes Entrance) Oil is now exploring deeper strata with special new drilling equipment in Gippsland, and at the same time is pushing ahead with exploratory drilling along the coastline. The Frome Lakes Co. is continuing with its well-drilling program (which will embrace 10 or 12 holes in all) despite lack of results in wells drilled to date. This company is considering drilling on leases along the north coastline of Queensland, but must delay any drilling program until the end of the wet season.

In Western Australia, a new well was spudded in the Kimberley district, at the Sisters Plateau, by Associated Freney Oil Fields NL, late in December.

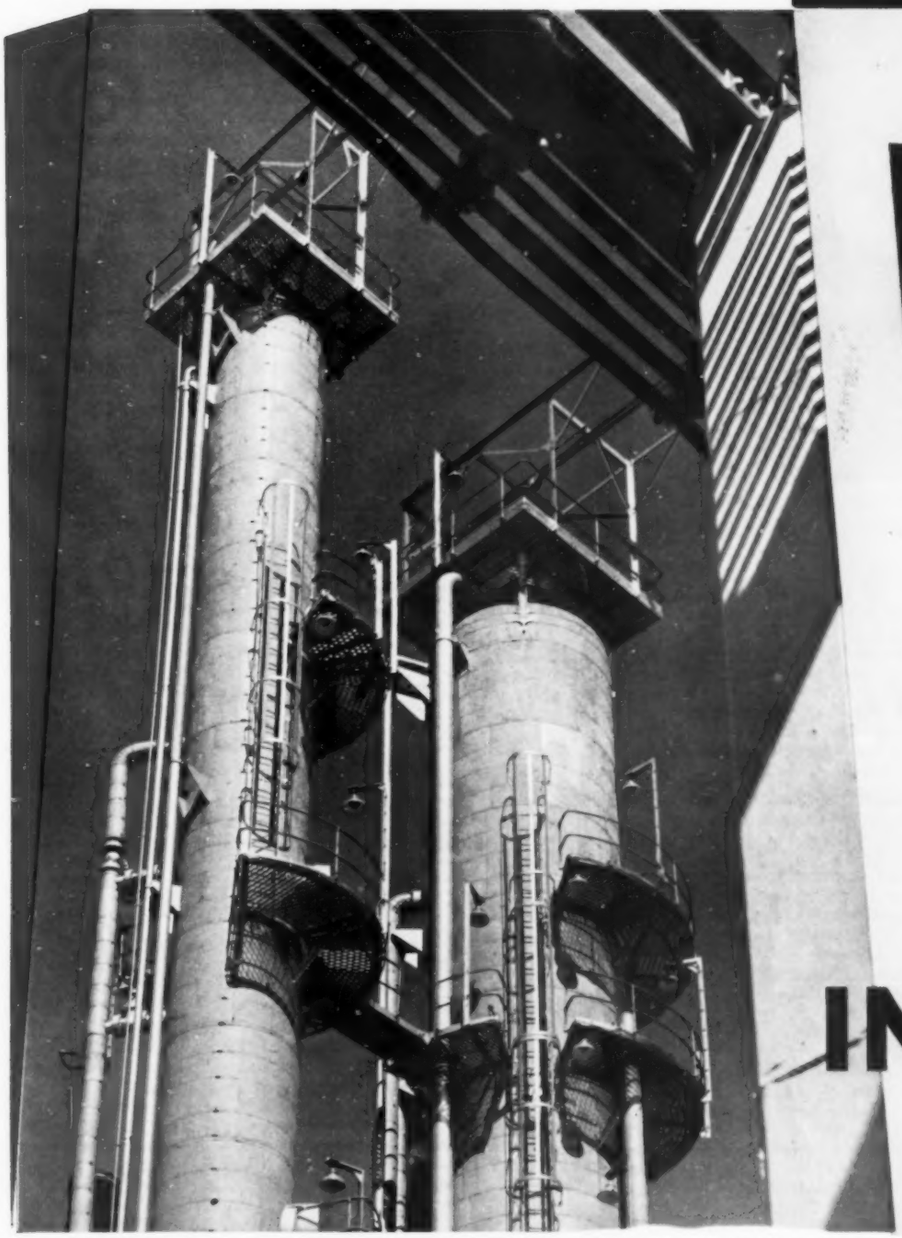
In New South Wales, Australian Oil and Gas Corp. continues to drill its test well at Dural, and has passed 3,406 ft. A further showing of gas was encountered at 3,063 ft. Drilling at Yass has been completed at 1,107 ft, as the required geological information has been obtained.

Africa

Algeria

The tempo of exploration in Africa has been increasing steadily, especially in Algeria. The recent finds in Algeria could supply all of France's needs in 15 years, according to M. Pierre Guillaumat, head of the French government's Oil Research Bureau. He recently predicted that France and her overseas territories would produce about 180,000

International



Paints

for the

OIL INDUSTRY

"Shell" Refining & Marketing Company Ltd: Part of the Platforming Unit, Shell Haven Refinery. (A Shell Photograph)

International Paints Ltd.

Head Office: **GROSVENOR GARDENS HOUSE, LONDON, S.W.1**

TELEPHONE: TATE GALLERY 7070 (15 LINES)

TELEGRAMS, INLAND: CORROFOIL, SOWEST, LONDON. OVERSEAS: CORROFOIL, LONDON

REGISTERED TRADE MARK

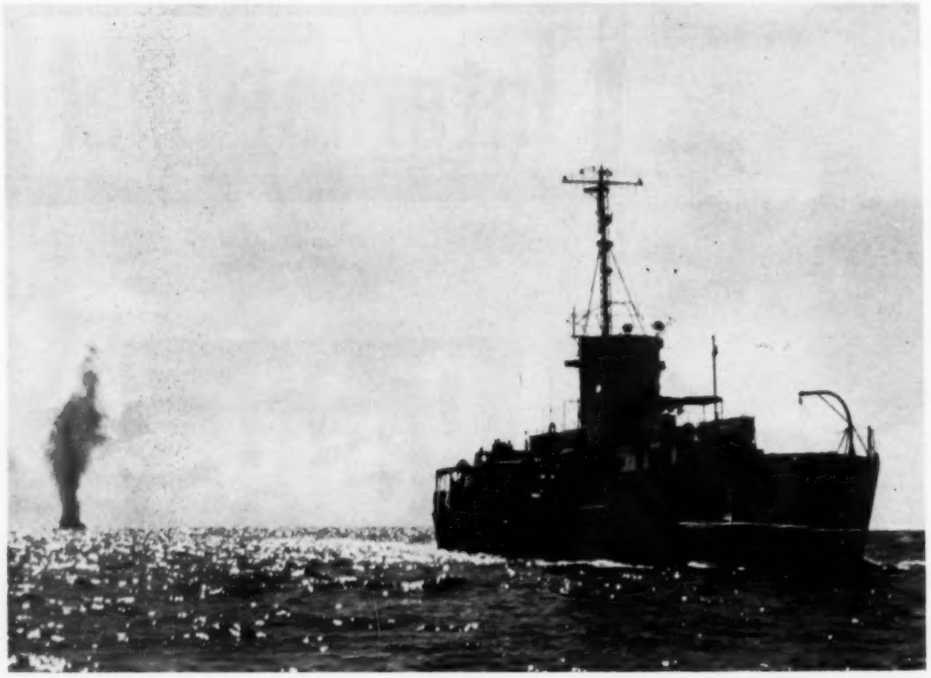
MAIN FACTORY IN U.K.—FELLING-ON-TYNE

ASSOCIATED FACTORIES IN

AUSTRALIA	MELBOURNE	FRANCE	ROUEN	NEW ZEALAND	AUCKLAND
AUSTRALIA	SYDNEY	GERMANY	HAMBURG	NEW ZEALAND	WELLINGTON
BRAZIL	RIO DE JANEIRO	ITALY	GENOA	SPAIN	BILBAO
CANADA	MONTREAL	ITALY	TRIESTE	SWEDEN	GOTHENBURG
CANADA	VANCOUVER	JAPAN	KOBE	U.S.A.	NEW YORK
DENMARK	COPENHAGEN	MEXICO	MEXICO CITY	U.S.A.	SAN FRANCISCO
FRANCE	LE HAVRE	NORWAY	BERGEN	VENEZUELA	MARACAIBO

"Vital plant and equipment protected by a thin film of paint..." an everyday thought, maybe, but a matter of deadly earnest to anyone concerned with the efficient running of an oil or petro-chemical installation. Nothing but paint protects the installation from the losses caused by corrosion: International paints, made specially for the oil industry, are of a quality that can be relied on to carry out this vital function with the maximum efficiency. For lasting protection, it is wise to specify International.

A WORLD-WIDE PAINT ORGANISATION



The M V Sonic of Geophysical Service Inc. is one of a group of vessels which have been specially fitted out for marine exploration.

b/d by 1961. He based his prediction principally on Algerian discoveries, but mentioned at the same time that French Equatorial Africa should yield about 7,000 b/d by the end of 1957. He predicted that 77 drilling rigs would be operating in the French territories during 1957.

The first of these strikes in the southern Sahara occurred during late 1955, when Edjele No. 101, a wildcat well by Compagnie de Recherches et d'Exploitation de Petrole au Sahara (CREPS), found oil and gas shows at 1,600 ft.

This discovery was followed by another at Tiguentourine (about 43 miles west of Edjele No. 101) now producing a reported 670 b/d of 35 API crude from the Lower Visean sands of the Carboniferous at 1,709 ft to 1,757 ft.

During May 1956 oil shows were reported by Cie. Francaise de Prospection Sismique (CFPS), an affiliate of Seismograph Service Corp., of Tulsa, operating for BRP. The shows were at 984 ft, in very compact Carboniferous sandstone formation, found during exploratory work near Reggane, about 150 miles west of In Salah and 450 miles southwest of Edjele No. 101 at 26° 42′ N, 0° 11′ E.

This, in turn, was followed by two recent discoveries. The first was about 47 miles southeast of the desert town of Ouargla. It is known as Hessi-Messaoud, located about 16½ miles from Hessi el Hadjar, a dry hole drilled by SN REPAL to 11,899 ft in 1955. Hessi Messaoud had over 340 ft of saturated quartzitic sandstone (Triassic) between 10,919 ft and 11,316 ft. A number of successful drill tests in this interval gave about 30 bbl per hour (about 720 b/d) through a ⅜-in. choke with the tool open 56 min. French press sources described it as a 3,600-square-mile field, with seven billion barrels reserve. The well was drilled by SN REPAL and Cie. Francaise des Petroles.

CEPA holds about 125,000 sq km of concession area, and is operating three seismic parties. Five wells were drilled in the first months of 1956, and light-oil shows were obtained north of Ghardaia.

CPA is operating three seismic parties, and drilled 6 exploratory wells during the first 9 months of 1956.

CREPS is operating three gravity crews and three seismic crews—with four rigs working in the eastern section of the company's exploration area, in the Ahnet basin. Large amounts of gas were found in the lower Devonian and oil shows at Thara 101.

Tunisia

Shell has discontinued exploration in Tunisia through Compagnie des Petroles de Tunisie, owned 65% by the Shell group and 35% by Societe de Recherches et d'Exploitations des Petroles en Tunisie.

The company started drilling in 1950. After oil shows had been found at Ktitir and Chorbane, south of Kairouan, it concentrated on the southern area, but production tests there proved disappointing. The group has spent $14.3-million.

Libya

Most of the world's major oil companies are represented in Libyan exploration, including Esso Standard Libya Inc. (Jersey Standard group); Nelson Bunker Hunt (independent US oil producer); Mobil Oil of Canada (Socony Mobil affiliate); Libyan American Oil Co. (an affiliate of Texas Gulf Producing, independent of Houston, Texas) (W. R. Grace & Co., USA, bought a 49% interest in Libyan American, and will advance some $7.5 million for exploration operations); Cie. Francaise des Petroles, in which the French government has a 35% stock interest; Amerada Petroleum Co. of Libya (parent company in USA is Amerada); Continental Oil Co. of Libya (owned by Continental, US); Oasis Oil Co. (Standard of Ohio affiliate); D'Arcy Exploration (Africa) Ltd. (a British Petroleum Co. affiliate); Anglo-Saxon Petroleum Co. (Shell group affiliate); and Texaco Overseas Petroleum Co., combined with California Asiatic Oil Co.—the two latter being affiliates of The Texas Co. and Standard Oil Co. of California, respectively.

Texas Gulf Producing Co. began an exploratory well during 1956, through its subsidiary, Libyan American Oil Co., in northern Cyrenaica, east of Bengasi. Oil shows were reported in the Cretaceous, but described as unimportant. The company has since abandoned the well and moved to a new location. Due to a misunderstanding about when it was to start drilling operations, the company recently lost the two most southerly concessions in Libya, No. 21 and 22, when they were revoked by the government.

The discovery of oil in Algeria at Edjele caused interest in that area of Libya adjoining Algeria. Cie. Francaise des Petroles received a new concession on the border, and Anglo-Saxon Petroleum Co. (Shell group) applied for an additional 3,360 square-mile concession opposite the Edjele discovery.

Egypt

Following the nationalization of the Suez canal and the resulting hostilities, the principal explorer in Egypt, Sahara Petroleum Co., pulled its personnel out, but by early 1957 had returned. Since it began operations in 1955 Sahara has drilled several deep tests without success.

Camdrill International Inc. (Southern California subsidiary) recently sold to International Egyptian Oil Co. for some $1,100,000 its 2 large drilling rigs in Sinai peninsula. Until Israeli invasion, Camdrill had operated rigs for International Egyptian.

Nigeria

Shell-D'Arcy group has recently completed a comprehensive water-borne seismic survey of all the navigable Niger delta waterways both in eastern and western Nigeria, covering an area of some 14,000 square miles.

This project, which involved the use of a fleet of 9 specially equipped boats and took over 2 years to carry out at a cost of about $560,000, is only part of a total expenditure of approximately $33 million incurred over the past 18 years by the Shell-D'Arcy group in its search for oil in Nigeria.

There are two companies exploring in Nigeria. Mobil Oil of Nigeria, a subsidiary of Socony Mobil Oil Co., has exploration rights covering the entire northern region, and Shell-D'Arcy has the general area of the Niger delta. The company recently announced a "good show" at 12,000 ft in No. 1 Oloibiri, an exploratory well drilled east of Port Harcourt. This was the eleventh in a series of exploratory wells in the area. The best previous well was at Akata, in Calabar Province, which had moderate shows of oil in 1954. Stepout drilling is planned to determine extent of the field.

The company will test production at Oloibiri, and the oil will be pipelined seven miles to Kugbo Creek for barging to Port Harcourt tankage, and then tanker-loaded for export.

Gambia

In the British colony and protectorate of Gambia, on the west coast of Africa, the D'Arcy Exploration Co. (a BP subsidiary) has embarked on a water-borne seismic survey of more than 200 miles of the River Gambia. The survey will be conducted by Geomarine Service Internationale from its vessel "Sonic," which recently completed some similar work in the waters off Abu Dhabi and Dubai in the Persian Gulf on behalf of British Petroleum Co. Ltd., and the Compagnie Francaise des Petroles. The present survey is planned to last about three months, it being a quicker method in this case than a similar operation on land where dense forests fringe the River Gambia. The land survey will probably be made later, after a study of the results of the water-borne survey.

Oil In Nigeria

Royal Dutch-BP second appraisal well at Oloibiri, eastern Nigeria, struck oil. Rig has been moved to site for a third well scheduled for March completion. Though discovery and two development wells have struck oil, proved area is not yet sufficient to justify permanent outlet facilities.

Gambia Oil Search

British Petroleum and (French) Bureau de Recherches de Petrole (BRP), as equal partners, are surveying Gambia. At the end of 1955 a preliminary 200-mile seismic water-borne survey was made of the bed and shore rock structure of the River Gambia, and currently a gravity survey of all syndicates' licensed areas is being carried out within the British colony and protectorate.

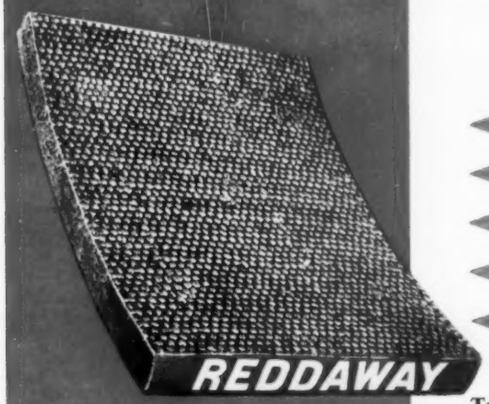
Work On Das Island

Approaching completion are base camps on Persian Gulf Das Island for first under-water test well by Abu Dhabi Marine Areas Ltd. One harbor breakwater, to be 800 ft long, has been carried out 650 ft. Airstrip is almost complete—with offices and living quarters well under way. A special drilling barge is being built on Germany's Kiel Canal.

LPG Plant In Austria

BP Benzin and Petroleum AG (BP associate) has opened new LPGas filling plant at Niklasdorf, near Leben, Austria—most up-to-date in central Europe. Capacity is about 500 10-kilo and 150 30-kilo bottles per 8-hour shift on 3 automatic filling and weighing machines.

LUCEY Export



REDDAWAY
OIL FIELD
Brake Blocks

Give you

- smoother, safer feed-off
- longer drilling life
- less wear on brake flanges
- faster installation time
- greater operating economy

Top quality Reddaway Oil Field Brake Blocks and Linings—metallic or non-metallic—are the choice of experienced drillers all over the world . . . because they provide the greatest combination of values of any comparable product! Smoother, more uniform friction always guarantees even, *safer* feed-off at all times under operator's direct control . . . *allowing more hole drilled per brake horsepower.* Reddaway brake blocks and linings *last longer* . . . put *less wear* and tear on your brake flanges . . . and *stay tight* because their bolt holes are doubly reinforced. Accurate sizing and drilling to close tolerances insure *faster installation, too!* For real operating economy over all types of drilling conditions, join the drillers who *know* . . . order Reddaway Brake Blocks from Lucey Export for your next job.

Reddaway "QUICK CHANGE" Rotary Blocks Also Available—Now you can bolt on Reddaway's rugged rotary blocks from the outside without removing the brake band! Crewman simply slides replacement block between band and drum and tightens bolts from the outside of the band. Drum is ready for operation in *70 per cent less time.* Special "SHAKE PROOF" nuts are firmly embedded in the block. The Reddaway is the only *bolt-on* type block that can be installed without removing the band. The brake bands therefore *cannot spring out of shape.* Either "Standard" or "Quick Change"—REDDAWAY BRAKE BLOCKS serve you BETTER!

Here's why

REDDAWAY MEANS BETTER BRAKE LININGS

Minimum cotton in asbestos cords eliminates carbonizing and glazing that cause erratic friction and lining failure.

Deep-penetration curing and impregnating in vacuum autoclaves produce a denser, more uniform brake block that resists heat, moisture, and oil . . . without excess volatiles that cause unpleasant odors.

Quality-control engineering gives precise degree of density and firmness to prevent grabbing and slipping. Standing and running friction are virtually identical, providing perfectly controlled braking on even the heaviest pipe.

Controlled hardness keeps metal splinters from imbedding in the lining . . . prevents major cause of brake flange scoring.

Scientifically designed brass ferrules and brass reinforcing wires assure double protection against loosening of Reddaway Brake Blocks in service.

Uniform construction, designed and drilled exactly to specifications . . . a size to fit every popular rig in current use.

Exclusive Exporters of Reddaway Brake Blocks

LUCEY Export

233 BROADWAY, NEW YORK 7, N. Y.

London Letter

By E. Lawson Lomax

A large amount of the UK publicity on oil-products shortage because of reduced supplies from the Middle East has gone to motor gasoline—which, although it has a significant effect on the country's economy, is really not so important as fuel oil consumed in manufacturing.

Petroleum Information Bureau figures for first 9 months of the year (before effects from Suez closing) showed total motor gasoline consumption of 4,844,855 tons—made up of 3,442,838 to dealers and 1,402,017 to commercial consumers, in addition to 437,465 of vaporizing oil and 1,321,795 DERV fuel.

A large proportion of motor gasoline sold to dealers undoubtedly is used for commercial purposes, but no breakdown is available. However, it may be assumed gasoline sold to commercial consumers, vaporizing oil, and DERV fuel totaling 3,161,277 tons definitely is used for commercial purposes.

Diesel and fuel oils, as well as refinery-consumption fuel oil, all may be classed as industrial fuel, and their use is as follows:

Shell Donates Laboratory

£20,000 has just been given by Shell Petroleum to assist in establishing a laboratory in sedimentology in the Department of Geology at University of Reading, England.

Whitby Gas Search

During past few months seismic reflection surveys have been carried out near Whitby, as a result of which Imperial Chemical Industries Ltd. and BP Exploration Co. will deepen a bore hole at Robin Hood's Bay—drilled in 1949-50 by Tisons Ltd. in a search for potash.

"Deltic-Engine" Vessels

First of three fast passenger launches built by John I. Thornycroft & Co. Ltd., Southampton, for Cia. Shell de Venezuela, recently completed successful trials in Southampton Water, and was delivered to its owners. The vessels employ "Deltic" type engines recently released by the Admiralty for commercial use. These vessels will operate on Lake Maracaibo. Each will carry up to 45 passengers at more than 30 knots. The launches are 68 ft 3 in. long, 17 ft 5 in. in breadth—with 5 ft 6 in. draft. Each is powered by 2 "Deltic" engines—fitted ahead and astern with reduction gearbox and driving a separate screw. Each engine is rated at 825 shp for Maracaibo climate. On trial, a mean speed of 31.2 knots was recorded.

UK Consumption (9 Months)

	Tons
Gas and diesel oils	1,720,624
Fuel oil	4,649,106
Refinery fuel	1,641,755

So, for the first months of the year, about 2/3 total oil-products consumption was fuel directly used in industry. Industry, therefore, is affected more by shortage than is th emotor industry.

Industry generally was turning to greater use of oil fuel because of coal shortage—with a 22% consumption increase in first 9 months, accompanied by 9% increase in gas and diesel oils.

Because of curtailed crude supplies from Middle East, rationing of heavy fuels was introduced—affecting all industry. Internal-combustion-engine manufacturing industry has been more widely affected, especially in motor transport where short-time working is prevalent. Already felt, hardship will accelerate. Other industries hit include construction—larger user of oil for energy. Baking is another.

Under ordinary circumstances, UK oil consumption would total about 25 million tons yearly—with an annual budgeted increase of 8%.

During November and December of 1956 some 3.6 million tons of crude were imported monthly from all sources—equal to an annual UK import of about 22 million—12% less than requirements; with refinery losses, this will rise to 14%. However, UK has continental commitments for refined oils; thus total short-fall of crude imports is much greater.

In 1955 crude imports were 27.9 million tons—assumed refinery throughput. During first 10 months of 1956 crude imports were about 30 million tons annually—actual total for year, about 28.6 million. Without considerable increase in November-December import rate, short-fall in coming year will be some 8 million, viz., 28% to 29%—with major portion applying to manufacture and industry. Without rapid change—either by renewal of normal Middle East deliveries or increases in exports from North and South America—the crude situation in the UK and Europe must become critical.

Blowpipe for Steam Line

Pipeline was constructed for Shell's Stanlow refinery—consisting of a 6-in. products line jacketed by an 8-in. steam line. George Wimpey & Co., contractors, called on British Oxygen Gases Ltd., to design a blowpipe for heating the end of the 8-in. line before closing over the 6-in. line. The blowpipe was made by using 2 standard CH-type blowpipe shanks as controls. Each blowpipe fed 20-in. x 1/16 in. jets, set at a 45-deg angle to the pipe—with a ¾-in. clearance all around and spaced at ¾-in. centers. Oxygen was supplied at 20 psi, and propane at 10 psi; and a steady clear flame raised 2 in. at the end of the pipe to a welding temperature in 4 min.

Rock-Wool Production

Cape Asbestos Co. Ltd. has activated a new furnace for "Rocksil" rock-wool production at its Sterling works. This is the only factory in Great Britain manufacturing a ling-fiber rock wool (made from natural dolomite rock, coming from firm's own quarry in Argyllshire).

Shell Haven Facilities

Matthew Hall & Co. Ltd. has been awarded a £300,000 contract for major offsite facilities at Shell Haven refinery of Shell Marketing & Refinery Co. Ltd.

"Drilpack"

Davey, Paximan & Co. Ltd., of Colchester, recently introduced a completely redesigned version of its "package" oil-well drilling set incorporating the type 12 RPH "Vee" form engine. Known as "DRILPAK" 400, set incorporates a range of 7 "Vee" engines from 4 to 6 cylinders normally-aspirated, and 12 to 16 cylinders pressure-charged—all cylinders of 7-in. bore x 7-3/4-in. stroke. Rating at 1,200 rpm ranges from 128 shp to 800 shp.

The "DRILPAK" incorporates fluid drive, in the form of a Vulcan Sinclair scoop-controlled fluid coupling capable of transmitting full engine torque from full engine speed down to about 520 rpm of the engine, with scoop in full-in position.

Domestic Heating

The 45 papers submitted to the Domestic Heating Conference of the Institute of Fuel, held May last—together with a full record of discussions—have been published in two volumes. Volume I was published in advance of the conference. Volume II, just published, completes the transactions. The second volume contains some important papers which arrived too late for inclusion in Volume I, as well as full record of contributions to discussions, replies, and summing up of the proceedings at the conference. Volumes I and II can be obtained from the Institute of Fuel, 18 Devonshire St., W.1; price, 31s. 6d. (plus 1s. 3d. packing and postage). Additional copies of Volume I can be supplied at 21s. (plus 1s. packing and postage).

J. L. N. Pollock

D. A. C. Dewdney,

Esso Petroleum Co. Ltd. has announced that J. L. N. Pollock, a director since 1938, retired from the board December 31, after having completed 37 years' service. D. A. C. Dewdney, manager of company's coordination and economics department, has been appointed a director to succeed him.

Mr. Dewdney obtained first-class honors in petroleum technology at Birmingham University, where he was also Cadman medallist. He joined Esso in 1936 as technical assistant, and held a number of important positions in research and refining operations. During the war he served in the Royal Air Force, and became wing commander. He was awarded the US Legion of Merit.

Personnel

Shell Petroleum Co. has announced the Honorable Sir Francis Hopwood (managing director of Shell Petroleum Co. Ltd. and a principal director of NV de Bataafsche Petroleum Maj.) has expressed a wish to retire from these offices as of June 30.

British Petroleum Co. Ltd. has announced that Basil R. Jackson has resigned from the board for health reasons, and the board has appointed to succeed him Neville A. Gass, CBE, MC.

Mr. Gass was born in 1893, and educated at Tonbridge School and McGill University, Montreal. During the 1914-18 war he held a commission in the Royal Artillery, and was awarded the Military Cross and the Belgian Croix de Guerre. In 1919 he joined Anglo-Persian Oil Co., and served in Persia until 1934, when he transferred to the London office. He has been a managing director since 1939, and appointed deputy chairman in April 1956. He was made a Commander of the Order of the British Empire in 1953.

British Hydrocarbon Chemicals Ltd. has appointed C. E. Evans, OBE, general manager—effective January 1, 1957.

Mr. Evans, after years of experience in petroleum, joined Anglo-Persian Oil Co. in 1939—serving with it in many capacities at Abadan, becoming works manager of Abadan refinery. Last among those to leave the refinery with evacuation in 1951, he received the OBE for his heroic services. He joined British Hydrocarbon Chemicals (at that time British Petroleum Chemical Ltd.) in October 1951, and was appointed general manager at Grangemouth in January 1954.

H. W. Rocke, managing director of Mobil Oil Co., has accepted a unanimous invitation from the committee of the Oil Industries Club to become club president for 1957.

Shell-Mex and BP Ltd. have announced that A. C. Durie was appointed general manager (administration), effective March 31, 1957—succeeding A. L. King, who will become general manager (sales) on the retirement of A. M. Mackintosh.

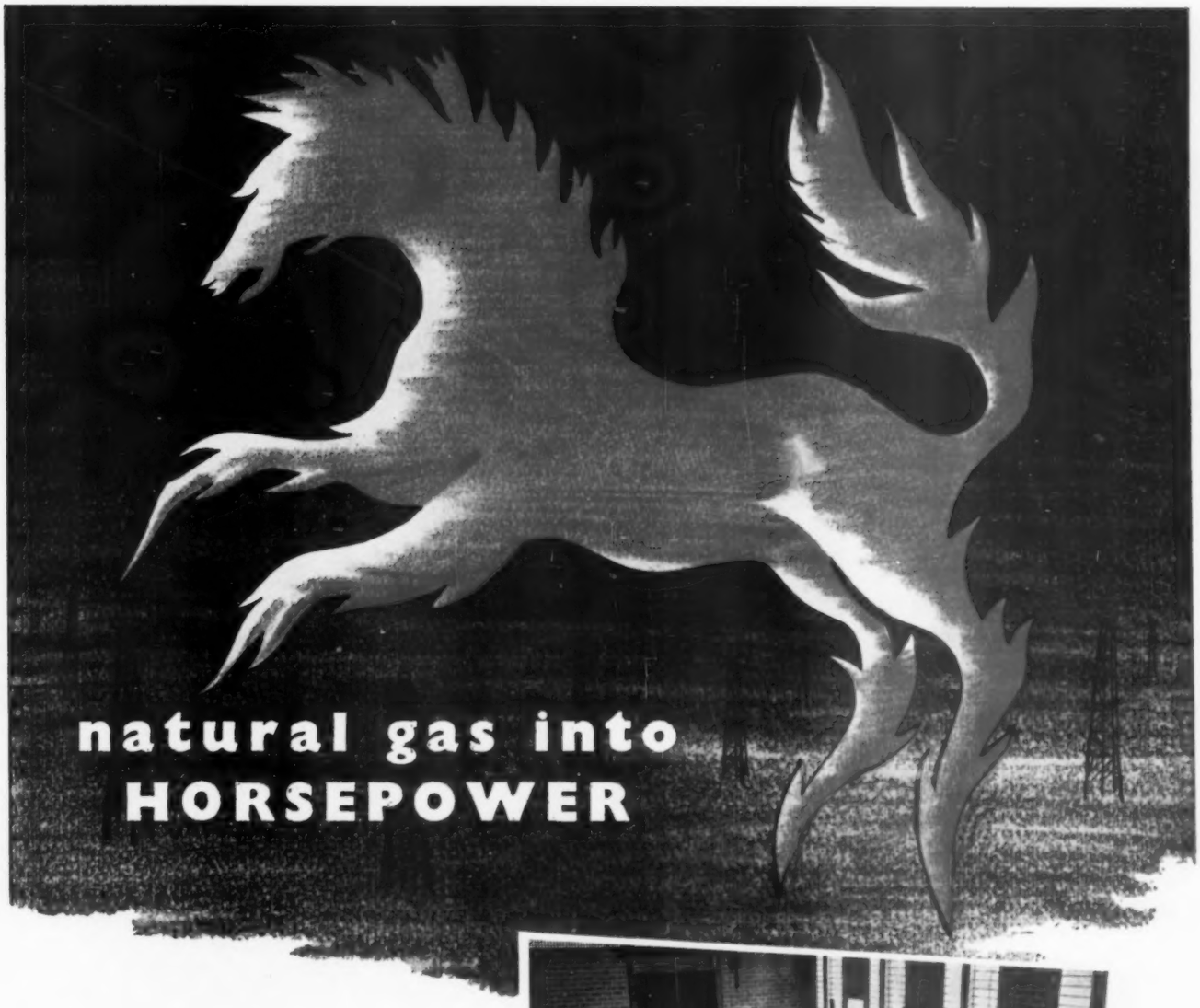
Mr. Durie joined the company in 1933; has held various important posts at home and in Australia—from which he returned recently. During the war he served in the Royal Artillery, in which he became a lieutenant colonel.

Chris Brasher has returned to his job with Mobil Oil Co. as assistant to the manager, supply department.

British Oxygen Gases Ltd. has appointed Frank Clark, MBE, as manager of sales technical-service department.

Mr. Clark was born at Meopham, Kent, and his first experience was in gas and metalarc welding at Royal Dockyard, Chatham; then he served with Royal Dutch-Shell group in Venezuela. He joined British Oxygen in 1936; he is co-author of *The Welding Repair Manual*, and a lecturer on welding.

COCHRAN BOILER CONSTRUCTION · NO. 5



Wherever there is natural gas, Ruston Gas Turbines are the most economical means of power *and heat* supply. These modern prime movers may be the answer to *your* power problem! . . . they are operating successfully in in every continent.

These Ruston Gas Turbines have been installed to run on natural gas and to supply power for the entire works of C.A. Cemento Carabobo Sucra, Valencia, Venezuela.

RUSTON GAS TURBINES

For details of these versatile, long-life power units, write for Brochure No. 9414X

RUSTON & HORNSBY LTD · LINCOLN · ENGLAND *Associated with Davey, Paxman & Co. Ltd., Colchester*

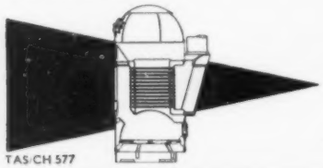
Built under licence for sale in the U.S.A., by Clark Bros. Co., Olean, N.Y., U.S.A.

Agents in the U.S.A. for Oilfield Services: Beckley, Haltom & Hickman, 1270 6th Ave., New York 20, N.Y., U.S.A.

A series of descriptions to demonstrate Cochran craftsmanship

The Furnace

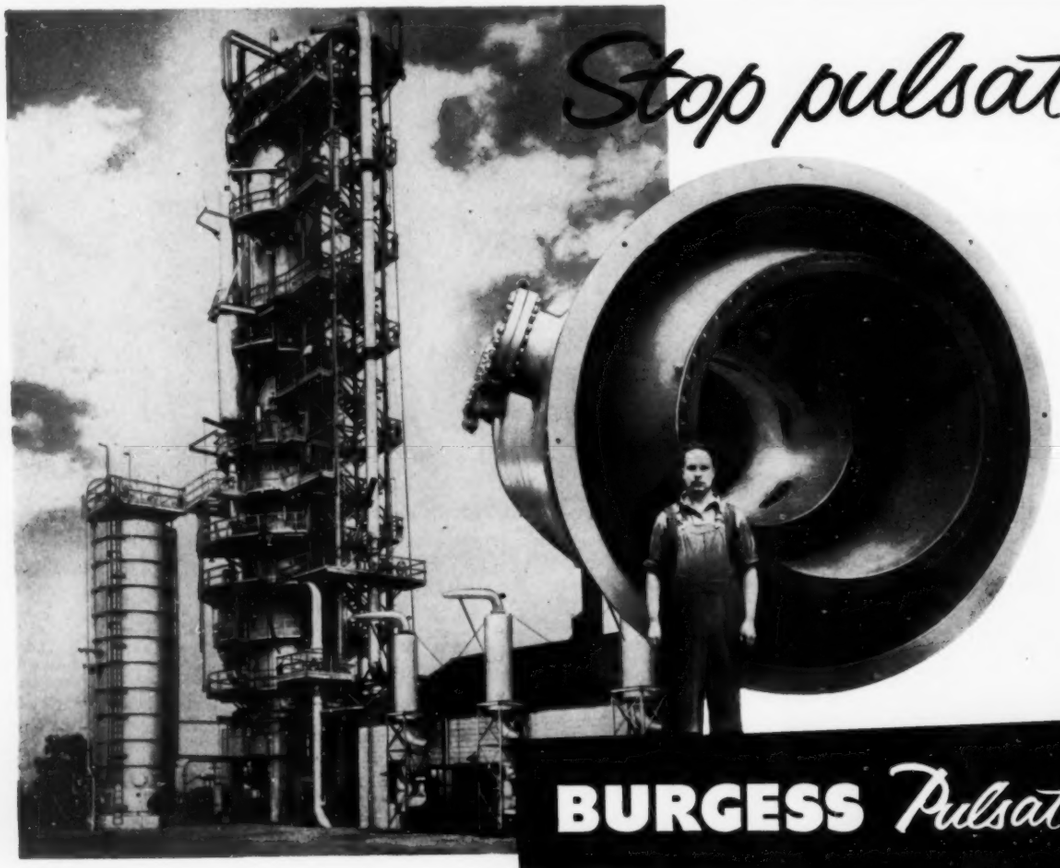
The heart of a Cochran boiler is the furnace, a dome of steel hot-pressed from a flat plate into a hemisphere without weld or seams; the absence of rivets enables it to withstand intense local heat, even such as is met when the boiler is oil-fired. The rivet holes in the furnace and ogee are drilled see illustration) whilst firmly held together with tack bolts. The tack holes, held in position by drifts through the holes previously drilled, are finally drilled out to size for riveting. Attention to detail is one of the reasons for the supremacy of the Cochran boiler.



TAS·CH 577

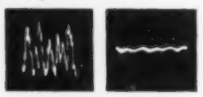
COCHRAN

Cochran & Co., Annan, Ltd., Annan, Dumfriesshire, Scotland, and at 34, Victoria Street, London, S.W.1



Stop pulsation . . .

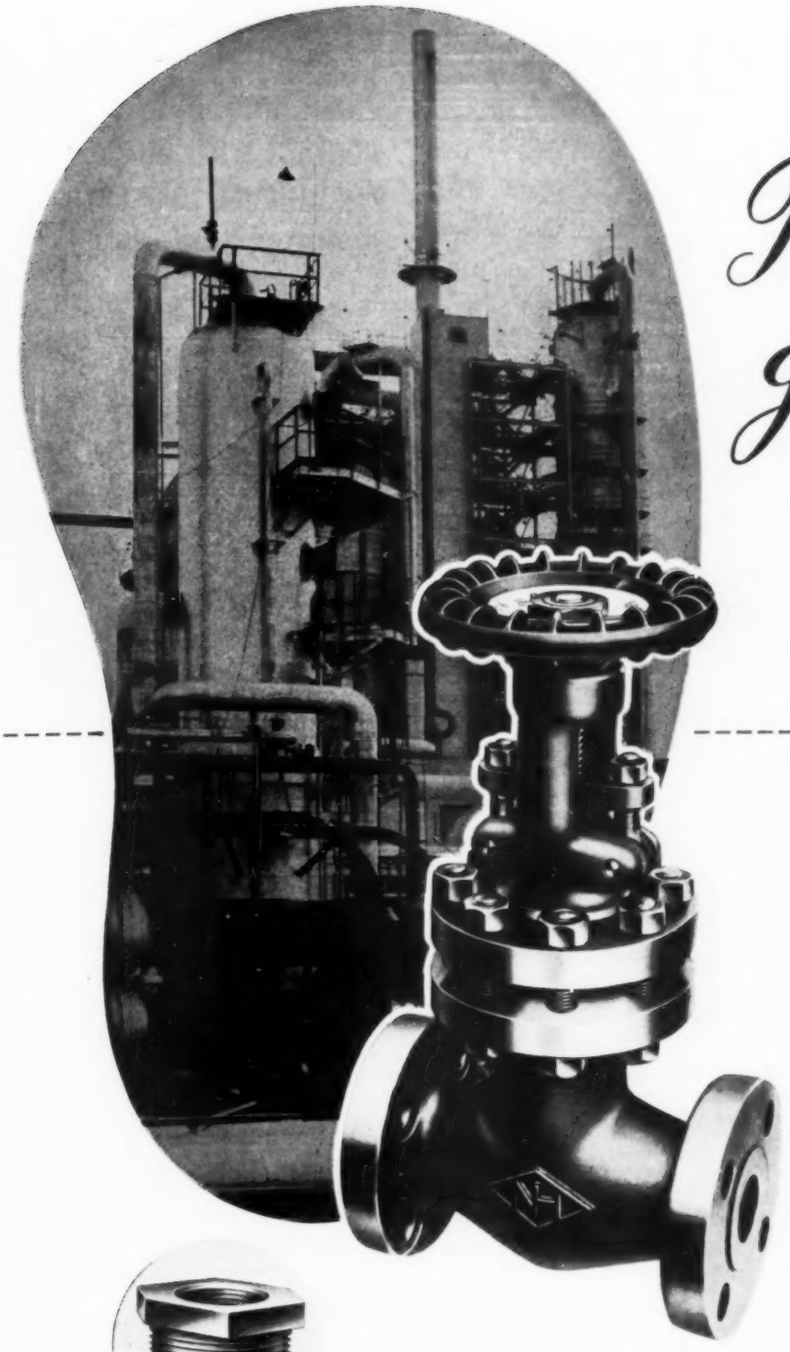
Pipes carrying gas and air under pressure from pumps, blowers, or compressors may fail, or require special reinforcement, as a result of surging and the consequent pulsatory vibration. This problem is overcome by fitting BURGESS Snubbers, which convert intermittent flow to smooth flow—and which, by eliminating a cause of line failure, often effect economies by permitting less costly pipes to be used. BURGESS Snubbers are made to the specifications and design of the original American BURGESS-MANNING patents.



Oscilloscope recording shows pulsation (left) and smooth flow attained after fitting BURGESS Snubber (right).

BURGESS *Pulsation Snubbers*

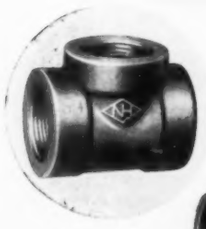
Designed by BURGESS-MANNING, DALLAS, TEXAS · Manufactured by BURGESS PRODUCTS CO. LTD., ACOUSTICAL DIVISION, HINCKLEY, ENGLAND.

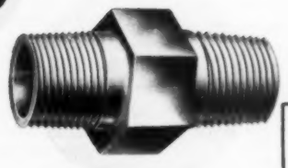


Results that Justify

NEWMAN, HENDER FORGED STEEL VALVES and FITTINGS

You will find Newman, Hender forged steel valves and fittings in the great refining plants throughout the world. They are there on account of their reliability, efficiency and sheer quality. Tested, tried and proved at every stage of manufacture, these valves please petroleum engineers because they are tight, easy to operate and very safe at all pressures and temperatures.





We manufacture a full range of FORGED STEEL FITTINGS screwed either A.P.I. line pipe or British Standard taper pipe thread or with socket weld ends. Elbows, Tees, Crosses, Double Male Nipples, Couplings and Bushings can be supplied with special reductions.

Newman, Hender & Co. Ltd

WOODCHESTER NH STROUD, GLOS.

Shell to Make Top-Level Changes Internationally

Sir Francis Hopwood, managing director of Shell Petroleum Co. Ltd. and principal director of NV de Bataafsche Petroleum Maj. (the two parent operating companies of the Royal Dutch-Shell group) will retire June 30. He will remain a managing director of "Shell" Transport Trading Co. Ltd., and a director of Shell Petroleum Co. Ltd.

H. Wilkinson, CMG, president of Canadian Shell Ltd. will become a managing director of Shell Petroleum Ltd., and a principal director of NV de Bataafsche Petroleum Maj. on July 1. He has been on "Shell" Transport & Trading board since 1948; since 1953 on the board of Shell Petroleum Co. Ltd.; and since 1954 on NV de Bataafsche Petroleum Maj. board since January 1954.

Compania Shell de Venezuela Ltd. has announced that Ian Davidson will resign the presidency as of June 30, but will remain a member of the board. He is to be appointed president of Canadian Shell Ltd., in Toronto, Canada to succeed Mr. Wilkinson. He also is to be appointed to the boards of Shell Petroleum Co. Ltd. and NV de Bataafsche Petroleum Maj.

Mr. Davidson is to be succeeded as president of Compania Shell de Venezuela by G. C. K. Dunstervilie, who has been on Shell's management in Venezuela since 1948 and a vice president since 1953.

New Swedish Supertankers

Trinity Tankers Corp. of New York has contracted, in Uddevalla, Sweden, for the construction of five 40,500 dwt supertankers, whose engine rooms will be equipped with General Electric Co. main propulsion and auxiliary machinery.

The vessels, each with a length of 710 ft, will be built by the Uddevalla Shipyard—the first is scheduled for launching in 1958. They will be used to transport Persian Gulf crude oil to the United States.

Caltex Increases Operations 10%

Caltex companies sold the equivalent of 218,000 bbl of crude oil and refined products in 1956, an increase of more than 10% over 1955, it was reported, in New York, by California Texas Oil Co. Ltd.

In 1956 Caltex companies and their affiliates also:

1. Spent $80 million for new equipment and supplies, 75% of which went into the economies of the 67 countries of the Eastern Hemisphere where Caltex companies operate.
2. Took delivery on 3 new tankers and authorized construction of 16 more.
3. Completed new refineries in Australia and Japan, installed new units in existing plants in Holland and France.
4. Entered the West German retail market in partnership with a local company.
5. Developed plans for a major expansion of crude-oil transportation facilities in Sumatra.
6. Continued a worldwide program of geological exploration, and development of existing fields.

This progress came about, says the company, "despite international developments which had some adverse effect on the orderly conduct of business. However, these developments were brought about by action of the governments involved, and naturally can be resolved only by them."

Tapline Reports 350,000 B/D Deliveries

Crude-oil delivered from Sidon, Lebanon, during December amounted to 10,765,606 bbl, an average of 347,278 b/d, according to the Trans-Arabian Pipe Line Co. This compares with 9,272,752 bbl (299,121 b/d) during the same period in 1955. During the year 1956, Tapline delivered 121,052,745 bbl of crude (330,745 b/d), compared with 116,499,994 bbl (319,178 b/d) during the year 1955.

Oil Inquiries to Portugal Large

The volume of inquiries about petroleum operations in Portugal has prompted the Ministry of Foreign Affairs to ask that all inquiries be referred to the ministry. This means "considerable" delay. Formerly, the Lisbon refinery (SACOR) had furnished statistics.

Washington Pipeline

(Continued from page 5)

The secretary added:

"Total demand for all oils also increased 5% over 1955. It rose sharply in the last two months of 1956 after blockage of the Suez Canal."

Oil refining companies paid out $1,317.8 million in cash dividends during 1956, it is reported by the US Department of Commerce. This compares with $1,171.5 million in 1955.

During December, the total was $380.3 million in 1956, and $344.3 million in 1955.

For perspective, all corporations issuing public reports on dividends paid out $11,256.3 million in 1956 and $10,434.8 million in 1955.

For all corporations, however, there was a drop in December 1956, compared with a year earlier—with the figures $2,217.4 million and $2,418.7 million, respectively.

Gas Bill Activity Reviewed

Senator John L. McClellan (D.,Ark.) chairman of a special Senate committee studying lobbying, finds little evidence of improper activity for and against the natural-gas bill a year ago.

In a progress report to the Senate, January 9, he said the committee will need more time to complete its study, which was to end January 31. The main job ahead, he said, is to come up with specific recommendations for lobbying. He said:

"The constitutional guaranty of the right of petition cannot be abridged.

"The committee believes there are some practices that are so clearly fraudulent and misleading that they should be prohibited by criminal penalties.

"But the greater problem is to spell out those legitimate activities which should be disclosed through registration and reporting.

"We hope the committee will be able to make recommendations to the Senate worthy of its consideration."

The special committee was created after President Eisenhower vetoed legislation, February 1956, to ease up federal price and other controls over independent producers of natural gas.

Senator McClellan pointed out that the President's veto message said "a body of evidence has accumulated indicating that private persons . . . have been seeking to further their own interests by highly questionable activities."

After hearing 146 witnesses in public session, and screening out 300 others in secret session, Senator McClellan had this to say:

"We assumed there was such a body of evidence which, if made available, would be most helpful to the committee in carrying out its responsibility. No such body of evidence, however, has been made available to the committee.

"We have done everything possible that is practical to secure the cooperation and assistance of our colleagues of the press, the public, and the executive branch of the government. The facts and information the committee obtained in response to these efforts were negligible."

In the courts came another aftermath of the natural-gas bill fight.

Elmer Patman, of Austin, Texas, and John M. Neff, of Lexington, Nebr., pleaded guilty to failing to register as lobbyists. Superior Oil Co. pleaded guilty to aiding the two in not registering.

US District Court in Washington, D.C., December 14, 1956, fined Patman and Neff $2,500 each. The court sentenced each of them also to 12 months in prison, but suspended the sentences. Superior was fined $10,000. The two men and the company were accused in an offer of funds to Senator Francis Case (R.,S.D.)

UOP Expands Petrochemicals Dept.

An expansion of the petrochemical process sales of Universal Oil Products Co. has been disclosed by M. P. Venema, president. Increased interest in petrochemicals by refiners who are studying the chemical field as a supplementary market has thrown a heavy load upon Universal, Mr. Venema says. Duties of new personnel include economic studies of specific refinery operations to evaluate the commercial application of petrochemical processes. They will also handle the sale and licensing of such processes to the industry.

To maintain close personal contact with our customers, Dresser operates world wide.

CLARK BROS. CO.
London, England

CLARK COMPRESSOR CO., LTD.
Calgary, Alberta, Canada

CLARK-ITALY, S.p.A.
Rome and Milan, Italy

DRESSER A.G.
Zurich, Switzerland
Caracas, Venezuela

DRESSER INTERNATIONAL, INC.
DIVISIONS:
CLARK BROS. PAN AMERICAN
IDECO • LANE-WELLS
PACIFIC PUMPS
ROOTS-CONNERSVILLE
SECURITY ENGINEERING
SOUTHWESTERN INDUSTRIAL ELECTRONICS
Buenos Aires, Argentina
Caracas, Venezuela
Mexico City, D.F.

DRESSER MANUFACTURING COMPANY, LIMITED, Toronto, Ontario, Canada

DRESSER MANUFACTURES (ENGLAND) LIMITED, London, England

LANE-WELLS CANADIAN COMPANY
Edmonton, Alberta, Canada

MAGNET COVE BARIUM CORPORATION, LTD., Calgary, Alberta, Canada

MAGCOBAR DE MEXICO, S.A.
Monterrey, N.L., Mexico

MAGCOBAR DE VENEZUELA, C.A.
Puerto La Cruz, Venezuela

PACIFIC PUMPS OF CANADA, LTD.
Edmonton, Alberta, Canada

PETRO-TECH SERVICE, C.A.
Caracas and Maracaibo, Venezuela

ROOTS-CONNERSVILLE BLOWER (CANADA) LTD., Toronto, Ontario, Canada

SECURITY ENGINEERING CANADA, LIMITED, Edmonton, Alberta, Canada

SECURITY ROCK BITS LTD.
Manchester and London, England

SOCIETE FRANCAISE DES INDUSTRIES DRESSER, S.A., Paris, France

SOUTHWESTERN INDUSTRIAL ELECTRONICS (CANADA) LTD., Calgary, Alberta, Canada

SOUTHWESTERN INDUSTRIAL ELECTRONICS DIVISION, DRESSER MANUFACTURES (ENGLAND) LIMITED, London, England

Dresser's European Headquarters: Dresser A. G. Muehlebachstrasse 43, Zurich, Switzerland

TOMORROW'S PROGRESS PLANNED TODAY

...by these Dresser Companies:

BOVAIRD & SEYFANG MFG. CO.
Bradford, Penn.

CLARK BROS. CO.
Olean, New York

DRESSER-IDECO COMPANY
Columbus, Ohio

DRESSER MANUFACTURING DIVISION
Bradford, Penn.

THE GUIBERSON CORP.
Dallas, Texas

IDECO INC.
Dallas and Beaumont, Tex.

LANE-WELLS COMPANY
Los Angeles, California
Houston, Texas

MAGNET COVE BARIUM CORPORATION
Houston, Texas

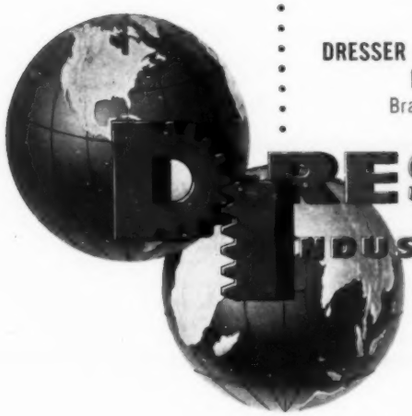
PACIFIC PUMPS, INC.
Huntington Park, Calif.

ROOTS-CONNERSVILLE BLOWER DIVISION
Connersville, Indiana

SECURITY ENGINEERING DIVISION
Dallas, Texas
Whittier, Calif.

SOUTHWESTERN INDUSTRIAL ELECTRONICS
Houston, Texas

WELL SURVEYS, INC.
Tulsa, Oklahoma



DRESSER INDUSTRIES, INC.

EQUIPMENT AND TECHNICAL SERVICES

OIL • GAS
CHEMICAL
ELECTRONIC
INDUSTRIAL

REPUBLIC NATIONAL BANK BUILDING, DALLAS, TEXAS

...with diversified sales throughout essential and expanding markets

OIL AND GAS

EXPLORATION

SIE—Complete seismograph systems, plotters and computers.

DRILLING

DRESSER MFG.—Fittings and couplings of many types for mud, water and fuel lines.
GUIBERSON—Swabs, packers, anchors, workover equipment—drilling heads, blowout preventers, tubing blocks, hooks, swivels, kellys, savers, unions. Molded rubber products.
IDECO—Masts, drawworks, Rambler drilling rigs, traveling blocks, rotary tables.
LANE-WELLS—Gun perforating services, well logging, packers and bridging plugs.
MAGCOBAR—Barite, bentonite and chemical additives for drilling fluids.
SECURITY—Rotary drilling bits, hole openers, reamers, casing scrapers.
WELL SURVEYS—Well logging systems and instruments.

PRODUCTION

CLARK—Engines and compressors for gaslift oil well pumping systems, pressure maintenance, recycling and repressuring operations and gas gathering systems.
DRESSER-IDECO—Steel buildings.
GUIBERSON—Gas lift equipment.
IDECO—Oil well servicing and workover rigs; petroleum equipment and supplies.
LANE-WELLS—Gun perforating services, well logging, packers and bridging plugs.
PACIFIC—Centrifugal pumps for natural gasoline plants, oil well plunger pumps.
SIE—Electronic instrumentation, computer systems.

REFINING

CLARK—Engines and compressors for cracking, vapor recovery and lube oil manufacture.
DRESSER MFG.—Couplings and fittings for piping systems.
PACIFIC—Centrifugal hot oil pumps, slurry pumps, cooling tower pumps, loading pumps.
ROOTS-CONNERSVILLE—Blowers and exhausters for refinery applications.
SIE—Electronic instrumentation, computer systems.

TRANSMISSION AND DISTRIBUTION

CLARK—Heavy duty engines and compressors for natural gas transmission lines.
DRESSER-IDECO—Steel buildings, Microwave towers.
DRESSER MFG.—Pipe line couplings, repair clamps and sleeves.
PACIFIC—Centrifugal pumps for crude as well as refined product pipe lines.
ROOTS-CONNERSVILLE—Gas boosters, meters, blowers.

CHEMICAL AND INDUSTRIAL

BOVAIRD & SEYFANG—Pipe and welding fittings.
CLARK—Engines, compressors and gas turbines for chemical processing, plant air and power.
DRESSER-IDECO—Radio and TV broadcasting towers, steel buildings, aircraft hangars, and mechanical parking garages.
DRESSER MFG.—Couplings and fittings for piping systems.
PACIFIC—Centrifugal pumps for chemical processing, electrical utilities and marine use.
ROOTS-CONNERSVILLE—Blowers, exhausters, vacuum pumps, meters, centrifugal compressors for chemical processing.
SIE—Electronic instrumentation, computer systems.

OUR HIGH QUALITY IS MAINTAINED...

IN ALL FITTINGS SUPPLIED TO REFINERY & CHEMICAL PLANTS

MILLENNIUM KEY

Please write for bulletins which give full technical information on each type of fitting.

Lake & Elliot Ltd.
BRAINTREE · ENGLAND

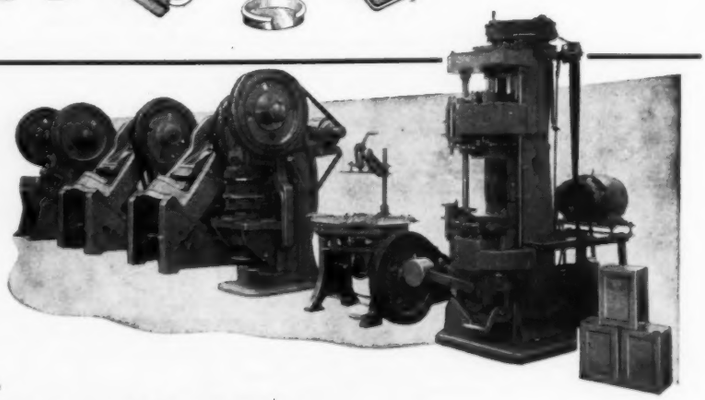
Telephone: BRAINTREE 1491

---

4 GALLON (IMP.) OR FIVE GALLON (U.S.A.) SQUARE PETROL TINS

COMPLETE PLANT *for High-Speed Continuous Production*

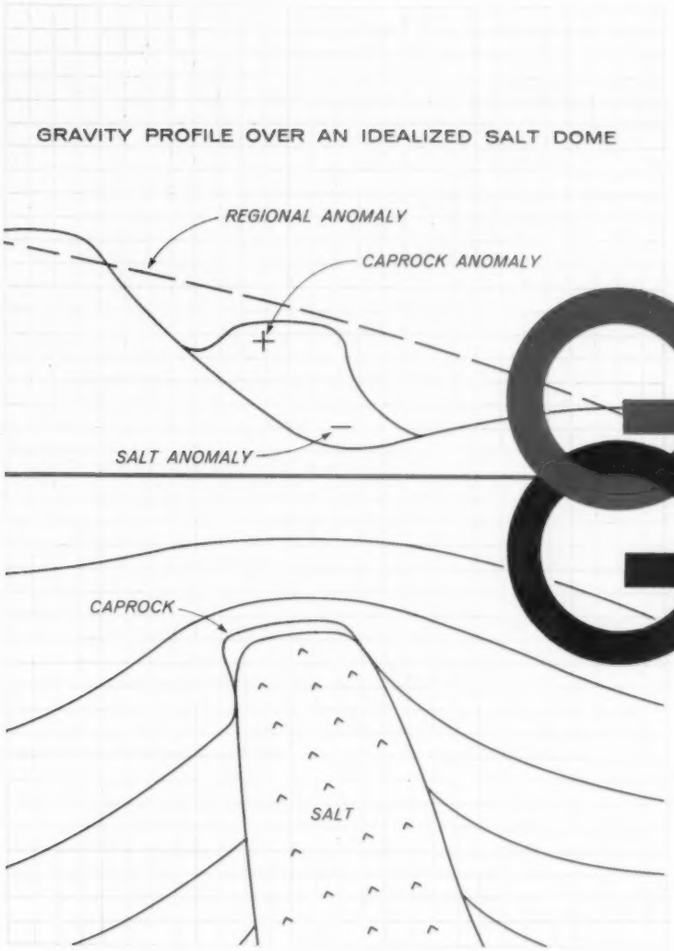
The battery of machines illustrated effects all operations, from the sheet to the finished petrol tin. MOON Machines provide speed of output and quality of finish and embrace all operations in metal box or drum manufacture. We shall be pleased to apply our experience to your problems. Reasonable deliveries can now be given. Writ for full details of any type of machine in which you are interested.



MOON
Regd. Trade Mark
MACHINES

MOON BROTHERS LIMITED • BIRKENHEAD

dm MB 74



GRAVITY & GEOLOGY

This diagram illustrates a gravity profile over an idealized salt dome. The salt, being of lesser density than the surrounding strata, produces a negative anomaly; the very dense caprock produces a positive anomaly.

By integrating all available information on local geology with *detailed* gravity data, GSI can utilize gravity surveys as a tool for solving your *specific* subsurface problems. GSI gravity interpretation reports are made available on a *current* basis... providing the information you need to make immediate decisions affecting your exploration program.

Write for Bulletin G57-1, describing GSI's Gravity Services.

GEOPHYSICAL SERVICE INC.

5900 LEMMON AVENUE • DALLAS 9, TEXAS

A World of Experience in Finding a World of Oil

International News and Notes

Oil Shortage Hearings

The oil lift for Europe is undergoing Congressional hearings, and opinions are widely split on what's to be done.

The US-Texas split was joined after Wormser asked the states to raise oil production to get more crude oil for Europe. In response, Chairman Olin Culberson of the Texas Railroad Commission said this would "almost wreck the domestic industry as there is too much gasoline on hand." Wormser's other proposal was for US refiners to take less crude oil—up to 200,000 b/d less has been suggested—and to make more fuel oil and less gasoline from what they used. Gasoline is the high-profit product.

Facts of the present situation have been locked up, even at this time, by US officials and major oil companies, so it is no surprise if public, states, and the oil industry are in the dark as to what's needed. A "situation" report at the Interior Department, which is being withheld from public and the industry, does give a measure of the shortage of crude for Europe.

During December, according to this document, the normal needs of Europe were 3,245,000 b/d. The supply was 3,066,000. Thus, the deficit was 179,000 b/d, which was pretty small for an area which brought on the mess itself, officials say. For the first quarter of this year, however, the picture is bleaker. The needs are 3,258,000 b/d, and the estimated supply is 2,765,000. This leaves a deficit of 493,000 b/d. The statistical picture shows a drop in oil from the Gulf Coast to Europe from 573,000 b/d to 340,000 b/d, and a drop of 150,000 b/d to 750,000 b/d from the Caribbean area to Europe.

Why the drop in liftings? The "situation" paper says the stocks have been moved out, and there just is no more oil without higher production.

Belgium and Luxembourg Consume 8½ Million Barrels

Consumption of petroleum products in Belgium and Luxembourg was running at the rate of 8,438,000 bbl a quarter just before the Suez Canal was closed.

This is the total, at least, for the third quarter of 1956. The figure is 22% higher than the total of 6,916,000 for the third quarter a year earlier.

Details by products follow:

CONSUMPTION — Belgium and Luxembourg
3rd Quarter (Thousands of Barrels)

	1956	*1955*
Avgas	75	68
Gasoline	2,421	2,407
Kerosine	381	391
Distillate and diesel	1,665	1,210
Fuel oil excluding bunkers	2,694	1,842
Bunkers:		
Distillate	26	24
Fuel oil	339	261
Lubricants	200	193
Other	390	283
Petroleum gas	247	237
	8,438	6,916

Exports of petroleum products in the 1956 third quarter came to 5,082,000 bbl, about the same as the 5,012,000 in the third quarter a year earlier.

Stocks on October 1, 1956 were 7,387,761 bbl, 10% above the 6,736,443 for the same date a year earlier. Of this, crude oil was 1,977,018 in 1956, compared with 1,648,689 a year earlier.

Details on exports, by product, and of stocks, by product, follow:

BELGIAN EXPORTS OF PETROLEUM PRODUCTS
3rd Quarter (Thousands of Barrels)

	1956	*1955*
Gasoline	866	806
Kerosine	380	354
Distillate and diesel	944	976
Fuel oil	2,451	2,489
Lubricants	147	125
Other		262
	5,082	5,012

STOCKS (Barrels)

	9-30-56		9-30-55
Avgas			
Gasoline	1,327,907		
Kerosine	273,495		
Distillate and diesel	1,431,752		
Fuel oil	1,491,050		
Lubricants	405,832		
Crude oil	1,977,018		1,648,689
Other	415,687		
Total	7,387,761	10%	6,736,443

Imports of crude oil in the 3rd quarter of 1956 came to 10,077,000 bbl, compared with 10,062,000 in the 3rd quarter a year earlier.

The imports of products came to 4,067,000 in the 3rd quarter of 1956, and 3,215,000 in the 3rd quarter a year earlier.

Details on imports of crude and products follow:

BELGIAN IMPORTS OF CRUDE AND PRODUCTS
3rd Quarter (Thousands of Barrels)

	1956	*1955*
Crude oil	10,077	10,062
Avgas	79	54
Gasoline	668	710
Kerosine	162	99
Distillate and diesel	1,164	734
Fuel oil	1,432	1,106
Lubricants	311	244
Other	88	96
Petroleum gas	163	173

Crude-oil runs to stills in the 3rd quarter of 1956 were 9,582,000 bbl, a drop from 9,912,000 bbl a year earlier. The drop was due to a 4-week shutdown of the Esso Standard Oil refinery at Antwerp (33,000 b/d average) which began in the middle of September for general revision of installations.

Details on refinery runs and production follow:

BELGIUM REFINERY PRODUCTION
3rd Quarter
(Thousands of Barrels)

	1956	*1955*
Crude runs	9,582	9,912
Other runs to stills	51	15
Gasoline	2,102	2,416
Kerosine	593	638
Distillate and diesel	1,865	2,051
Fuel oil	3,944	3,557
Lubricants	44	40
Other	535	383
Losses	550	843
Avgas	—	—

Switzerland Consumes 70,000 B/D Oil Products

US officials estimate the consumption of fuel oil and gasoline in Switzerland in 1956 at approximately 3 million metric tons (60,000 b/d), and in 1957 at 3.5 million metric tons (70,000 b/d).

Actually consumption for 1955 was given as 1,159,000 metric tons of fuel oil and 541,000 tons of gasoline, and a total of 1,891,000 metric tons of gasoline, fuel oil, and mineral oil.

New Bunkering Facilities at Madeira

A contract is reported to have been signed between Portuguese government and Shell Portuguesa SARL by which the company will spend some £750,000 on bunkering facilities at port of Funchal. Contract provides exclusive right of company to bunker shipping at Madeira for the next 25 years.

Errata

Bechtel Corp. is not making a pipeline survey in the Middle East at present, as erroneously reported in press sources. It made a survey about three years ago in conjunction with the OEEC (Organization for European Economic Cooperation), but nothing further.

Rigs To Be Moved by Helicopter

Helicopters will be used to move drilling rigs from location to location in Papua, on the island of New Guinea. The Australasian Petroleum Co., which has operated in Papua since 1938, will adopt the air-lift method for jungle areas where there are few, if any, roads. It will use two type 50 rigs, made by The National Supply Co., sectionalized so that no load will exceed 4,000 lb. The method of disassembly permits the rigs to be rigged up quickly at location.

Helicopter shown in photo is a Sikorsky S-58 carrying a 4,000-lb load during a test flight over Houston, Texas.

Syrian Oil-Discovery Analysis

Crude oil discovered in the northeast part of Syria, at Karatchok, has been analyzed by the American University at Beirut, it was disclosed by Menhall Oil Co.

Analysis indicates specific gravity of 0.9294 at 50°F; gravity, 20 API; viscosity, at 70°F, 176.25 centipoises; flash point, 22 C at initial distillation; asphalt content, 15.42%; hydrogen sulfide, trace; distillate, 15%; gasoline, 23%; kerosine, 7%; diesel oil, 14%; and fuel oil, 29%.

Gulf Withdraws from Italy

Gulf Oil Corp. has confirmed its decision to withdraw from all oil exploration activities on the mainland of Italy. Gulf, through a subsidiary, Gulf Italia, became interested in Italy about seven years ago. Subsequently an important discovery near the Adriatic coast was made in association with Montecatini, an Italian company.

Gulf said its action was necessary in view of the economically unattractive hydrocarbons bill recently passed by the Italian parliament which makes it impractical for the company to continue operations there.

The company's decision to cease operations on the mainland of Italy does not apply to its operations in Sicily, where the regional oil law of 1950 provides more attractive features than the new Italian law. Rather, the company said, it will continue to develop the promising Ragusa field, discovered in 1953; and its exploration activities elsewhere in Sicily will go forward at an accelerated rate.

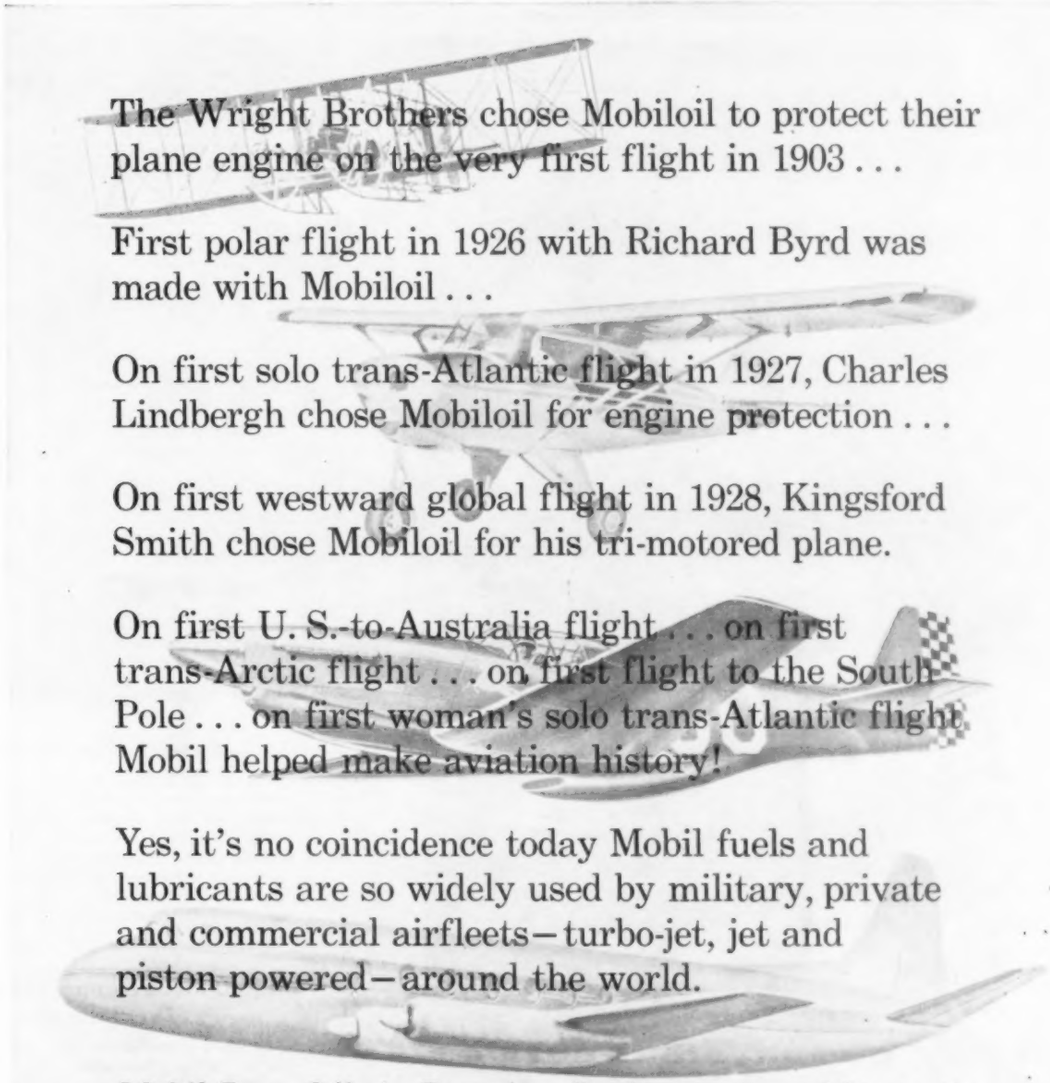
Pemex Reports on Mexican Oil

Crude-oil production in Mexico was 94,200,000 bbl last year, the highest total in any year since 1926, according to Sen. Antonio J. Bermudez, director-general of Petroleos Mexicanos.

At the start of the year, demand was 238,800 b/d, compared with 180,600 b/d in 1952. Demand for natural gas was 180 million cubic feet in 1956, compared with 146 million cubic feet in 1952.

Mexico has 6,094 km of oil and gas lines, of which 1,863 km were laid in the last 4 years, according to the senator; and refining capacity stand at 318,000 b/d, a gain of 60% since 1952. In the past 4 years, Mexico has begun catalytic cracking of its own crude oil. Storage capacity stands at 451,200,000 liters as of the start of this year, compared with 310,000,000 liters at the start of 1953.

It's no Coincidence...



The Wright Brothers chose Mobiloil to protect their plane engine on the very first flight in 1903 . . .

First polar flight in 1926 with Richard Byrd was made with Mobiloil . . .

On first solo trans-Atlantic flight in 1927, Charles Lindbergh chose Mobiloil for engine protection . . .

On first westward global flight in 1928, Kingsford Smith chose Mobiloil for his tri-motored plane.

On first U. S.-to-Australia flight . . . on first trans-Arctic flight . . . on first flight to the South Pole . . . on first woman's solo trans-Atlantic flight Mobil helped make aviation history!

Yes, it's no coincidence today Mobil fuels and lubricants are so widely used by military, private and commercial airfleets—turbo-jet, jet and piston powered—around the world.

Mobil Pays Off—in Progress, Performance and Protection

SOCONY MOBIL OIL COMPANY, INC.

and Affiliates: MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORPORATION

Left to right are Colonel Hassein Ghodessi and Lieutenant Colonel Mahamad Mahdavy; Virgil Kauffman; Brigadier General Nowtash; and Edgard Davis.

Study American Map Making

Brigadier General M. Nowtash, chief of the Iranian Geographic Department, and two of his staff officers, as well as a staff officer for the Ministry of War, visited Aero Service Corp., Philadelphia, late last December. Purpose of their visit was to review American map-making methods.

Fourth Italian Platformer Onstream

The fourth Universal Oil Products Co. Platforming unit to be completed in Italy has gone onstream at the Industrie Chimiche Italiane del Petrolio refinery.

The new 2,300 b/sd Platforming unit produces a 90- to 92-octane F1 clear debutanized Platformate from a Kuwait naphtha charging stock. With this new plant, the refinery can produce premium gasoline with a 98- to 100-octane rating, leaded.

Neal Goes to London for Middle East Post

Earl S. Neal, a director of Imperial Oil Ltd., resigned, as of February 1, to accept the position of deputy representative on Middle East matters for Standard Oil Co. (N.J.). His offices will be in London. L. D. Fraser has been elected a director to succeed Mr. Neal.

Mr. Neal, a petroleum engineer and geologist, came to Imperial in 1952 after wide experience in the USA and South America. Mr. Fraser joined Imperial in 1928 in Montreal.

C. T. Wright succeeds Mr. Fraser as general manager of marketing operations.

New Stanvac Tankers for Southeast Asia Traffic

Contracts for an additional 27,900 dwt of oil transportation capacity for Standard Vacuum Oil Co.'s fleet have been signed with Ottensener Eisenwerk, Hamburg, Germany. With 4 other tankers already under contract in Japan, Sweden, and France, Stanvac now has more than 160,000 dwt of tanker capacity on order. The Ottensener project covers two 13,950-ton shallow-draft oil-product carriers for use in Southeast Asia. To cost $4 million each, the 127,000-bbl vessels are for delivery early in 1961. Each will be 490 ft long, 75 ft deep—with a draft of 23 ft 6 in. and a speed of 14 knots.

Israel to Pay for Damages

An Israeli Foreign Ministry spokesman said recently in Jerusalem that Israel would pay compensation for any material damage suffered by the Italian petroleum companies which have oil installations in the Sinai peninsula. He was referring to an earlier statement by United Nations force Commander General Edeson Burns concerning the condition in which he had found the Sinai oil works.

250,000-Acre Concession Granted in Philippines

Benguet Consolidated Inc. has joined the search for oil in the Philippines. The company has been granted an oil exploration concession covering some 250,000 acres in Mindanao (provinces of Bukidnon, Cotabato, and Lanao). J. C. Bardey, company vice president, announced that E. O. Bennett, petroleum consultant, was to arrive in February to take charge of preliminary exploration work.

Gas Found in Vienna

Kagran No. 8, an exploratory well within the city limits of Vienna, found gas between 6,942 ft and 6,956 ft, December 15, 1956. Drilled by the Austrian Mineral Oil Administration, Comp. (Oe.M.V.-A.G.), Kagran No. 8 is the second gas well on Vienna territory. Kagran No. 8 has been closed for safety reasons, as pressure is likely to rise. Oe.M.V.-A.G. reportedly plans to intensify drilling operations in a new, promising area at Rabensburg near the Thaya River (northeastern Lower Austria). The size of the Rabensburg field is estimated at 0.62 square miles. Half of the structure extends into Czechoslovak territory. The Czechs are drilling in their territory.

a *Complete* geophysical service

FOR POSITIVE RESULTS AND HIGH PRODUCTION, YOU CAN DEPEND ON TIDELANDS' EXPERIENCED CREWS

- Seismic, gravity, and magnetic surveys on land and sea
- Reinterpretations
- Radioactivity surveys
- Core drilling
- Density logs

Tidelands

EXPLORATION CO. • GEOPHYSICAL CO., INC. • OFFSHORE, INC. • OVERSEAS, INC.

THE "SPYROS NIARCHOS" the largest

single-screw, single-purpose oil tanker in service, has recently completed her trials.

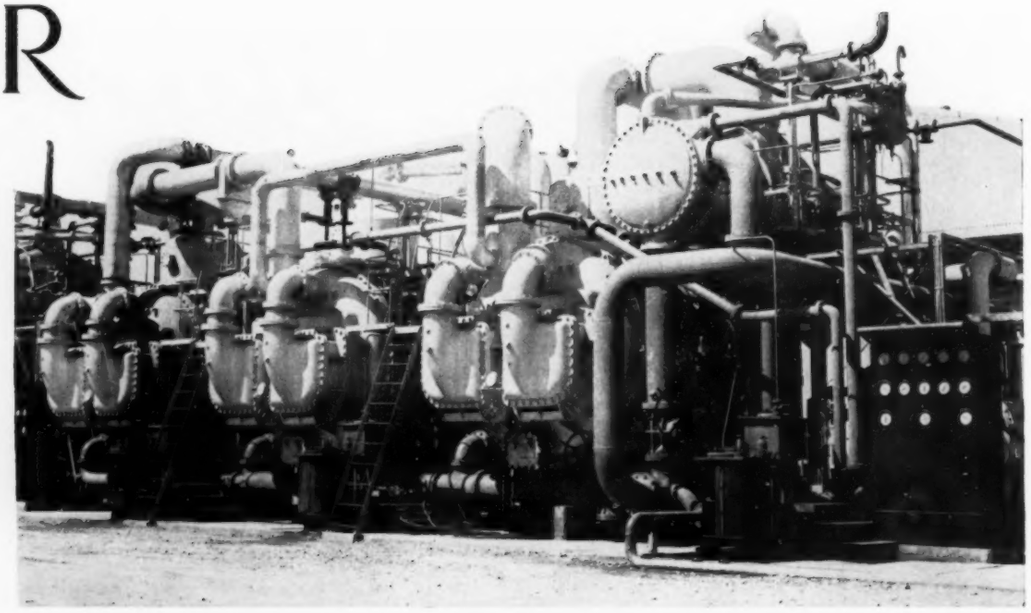
On an overall length of 757 feet she carries 47,000 tons deadweight and has a maximum power of 20,000 S.H.P. She is propelled by the largest, solid Novoston propeller of Heliston design yet manufactured. It is five-bladed and weighs 30½ tons.

Photograph by courtesy of the builders, Vickers-Armstrongs (Shipbuilders) Ltd.

J.STONE & CO. (CHARLTON) LTD.

OCEANIC HOUSE 1A, COCKSPUR ST., LONDON S. W. 1

WEIR



SEA WATER

EVAPORATING & DISTILLING PLANTS

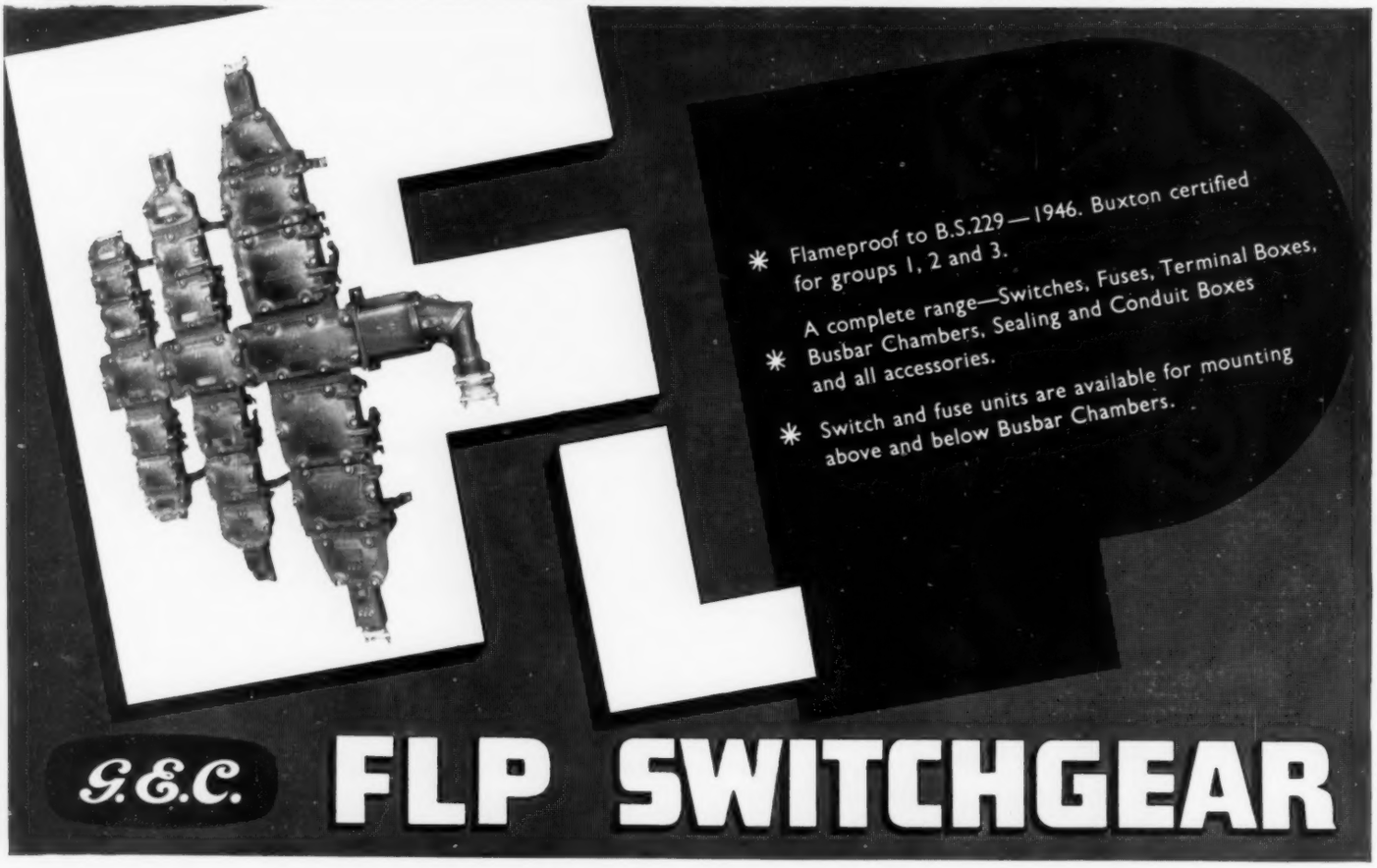
by providing ample supplies of fresh water distilled from sea water, have made possible the economic development of many areas with no natural supply of fresh water.

Ships too, with Weir Evaporators, can make the longest voyages without buying fresh water en route, leaving more room for paying cargo, and always being sure of pure fresh water for all the ship's services.

Write for Publication No. IL. 151.

Illustrated: WEIR TRIPLE-EFFECT SEA-WATER EVAPORATING AND DISTILLING PLANT AT THE ADEN REFINERY OF THE BRITISH PETROLEUM CO., LTD. IT PRODUCES 134,000 GALLONS OF FRESH WATER A DAY FROM SEA WATER.

G. & J. WEIR LTD
CATHCART · GLASGOW

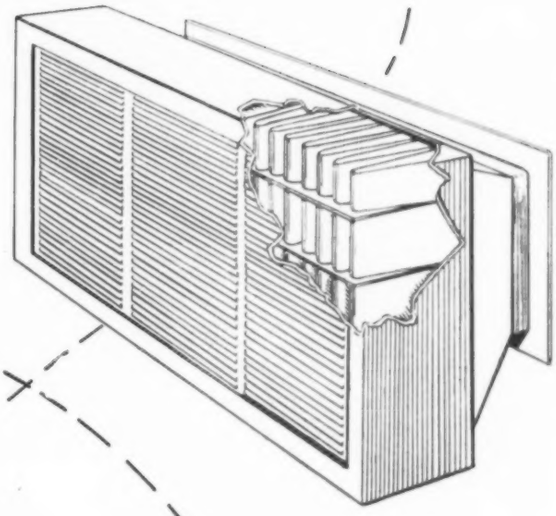

FLP
* Flameproof to B.S.229—1946. Buxton certified for groups 1, 2 and 3.
* A complete range—Switches, Fuses, Terminal Boxes, Busbar Chambers, Sealing and Conduit Boxes and all accessories.
* Switch and fuse units are available for mounting above and below Busbar Chambers.
G.E.C. FLP SWITCHGEAR

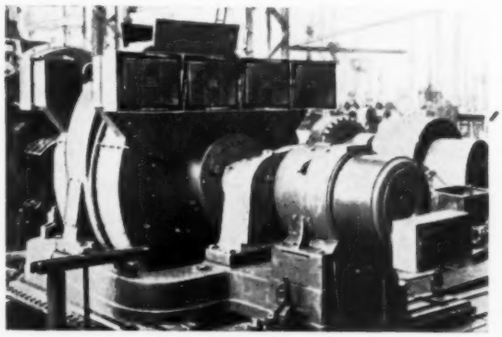
THE GENERAL ELECTRIC COMPANY LIMITED OF ENGLAND

VOKES FILTERS

play a vital part in keeping the oil flowing...

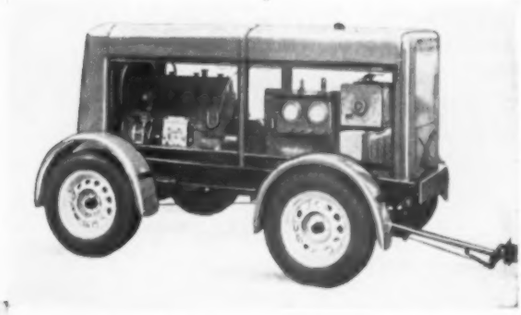
In the blinding desert dust storms which sweep the area of the Iraq pipelines, VOKES filters have twice been chosen for the important task of protecting pumping stations and ancillary equipment . . . proof indeed of the important part which VOKES filtration is playing throughout the world in safeguarding plant and machinery from wear, breakdown and unnecessary depreciation. Below are shown three typical aspects of VOKES protection . . . protection which cannot be jeopardized by the non-availability of element replacements because VOKES FILTERS ARE CLEANABLE.





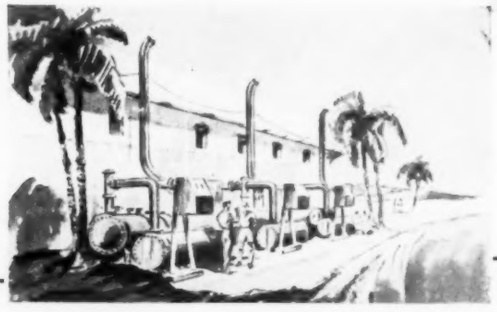
MICRO-VEE PANEL FILTERS FOR ELECTRIC MOTORS

Electric motors breathe too! . . . and these VOKES filters have proved conspicuously successful in preventing the grave damage hitherto sustained during operations in impure air conditions.



VOKES FILTERS FOR ANCILLARY EQUIPMENT

Compressors . . . portable generators . . . welding sets . . . power packs . . . all need protection against the ingress of abrasive dust, whether by air-intake, lubricating oil or fuel.



VOKES FILTERS FOR STATIONARY DIESEL ENGINE

Under abnormal conditions like these, engines have to be doubly protected and these large diesel engines are therefore fitted with Microvee dry fabric filters for cleaning the intake air. Vokes Filters are also specified for atmospheric air filtration in the ventilating systems of many of the desert buildings.

VOKES LIMITED

VOKES LIMITED. *Head Office:* **GUILDFORD, SURREY, ENGLAND**

London Office: 123, Victoria Street, Westminster, S.W. 1 • Vokes (Canada) Ltd., Toronto • Represented Throughout the World • Vokes Australia Pty. Ltd., Sydney

V116A

Oil Company Staff Changes

JACK L. HOLLIS has been named exploration coordinator for British American Oil Co., Oil and Gas Bldg., Tulsa, Okla.

SHERMAN L. VENCIL has been named area geophysicist of the company's southern and southwestern divisions, Mellie Esperson Bldg., Houston, Texas.

ELMER O. MATTOCKS has been named director of the department of technical services of the American Petroleum Institute. He has been assistant director for the past several years and succeeds David V. Stroop, who now will devote all of his time to his duties as executive assistant to the president.

EUGENE HOLMAN, chairman and chief executive officer of Standard Oil Co. (New Jersey), has been elected a member of the board of Metropolitan Life Insurance Co. Mr. Holman continues to retain his present post with Jersey Standard.

DANIEL S. JOHNSTON, H. J. Stroud, and James K. Wootan have been elected directors of Signal Oil and Gas Co. Mr. Johnston is a assistant manager of the crude-oil producing department. Mr. Stroud is manager of the industrial and public-relations department. Mr. Wootan is manager of the land and lease department, and joined Signal in 1946.

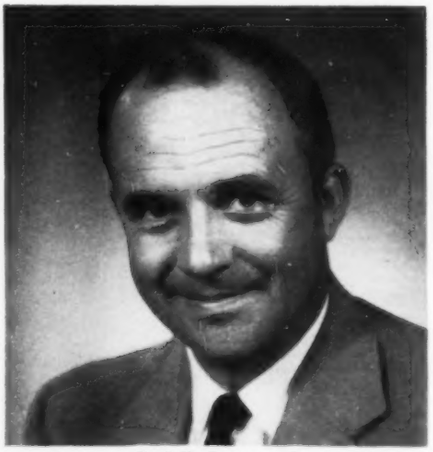
Oscar John Dorwin

Mr. Mangelsdorf

OSCAR JOHN DORWIN has been elected a director and Theodore A. Mangelsdorf a vice president of The Texas Co. Mr. Dorwin has been a vice president since 1951 and general counsel since 1944. As a director, he replaced R. F. Baker, executive vice president of the company, who retired February 1. Mr. Mangelsdorf was named general manager of the domestic refining department in July 1954.

Mr. Dorwin joined the company in 1931 when Texaco acquired the Indian Refining Co., of which he was general counsel.

Mr. Mangelsdorf, who will carry out special assignments for the chairman, joined the company in 1933 as a chemical engineer. He served as superintendent of Texaco's Port Arthur, Texas, and Lockport, Ill., refineries, and as manager of the refining department's operations division, prior to becoming general manager of that department.

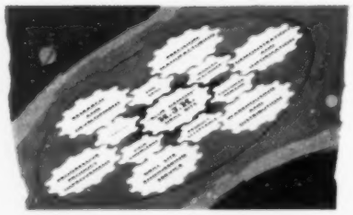


Fred H. Ramseur, Jr.

FRED H. RAMSEUR, JR. has been appointed coordinator of light-ends and natural-gasoline plants for Cities Service Co. Mr. Ramseur for several years has been manager of the natural-gasoline division of Arkansas Fuel Oil Corp., with headquarters at Shreveport.

E. DUMONT ACKERMAN has joined International Petroleum Co. Ltd., in Coral Gables, Fla., as exploration coordinator. Mr. Ackerman transferred to Coral Gables from International Petroleum (Colombia) Ltd., in Bogota, Colombia, where he was exploration manager, and later acting general manager.

E. Dumont Ackerman



. . . geared for greater shot hole drilling progress in the International Geophysical Year

"BLUE DEMON" BIT RESEARCH
begins, continues and never ends with
FIELD OPERATIONS!

Since development of the very first "Blue Demon" Replaceable Blade Bit for improved shot hole drilling efficiency at lower cost, research has been a continuing habit at Hawthorne . . . with every area of operations serving as a constant proving ground for continual product improvement.

From thoroughly engineered blade designing through constant metallurgical research for maximum structural strength and wear resistance, Hawthorne "Blue Demon" Bits have always been intended to provide greatest drilling efficiency and versatility, in the widest range of formations, under a variety of drilling and equipment conditions . . . to produce greatest possible footage at consistently lowest cost, for the most shot hole customers.

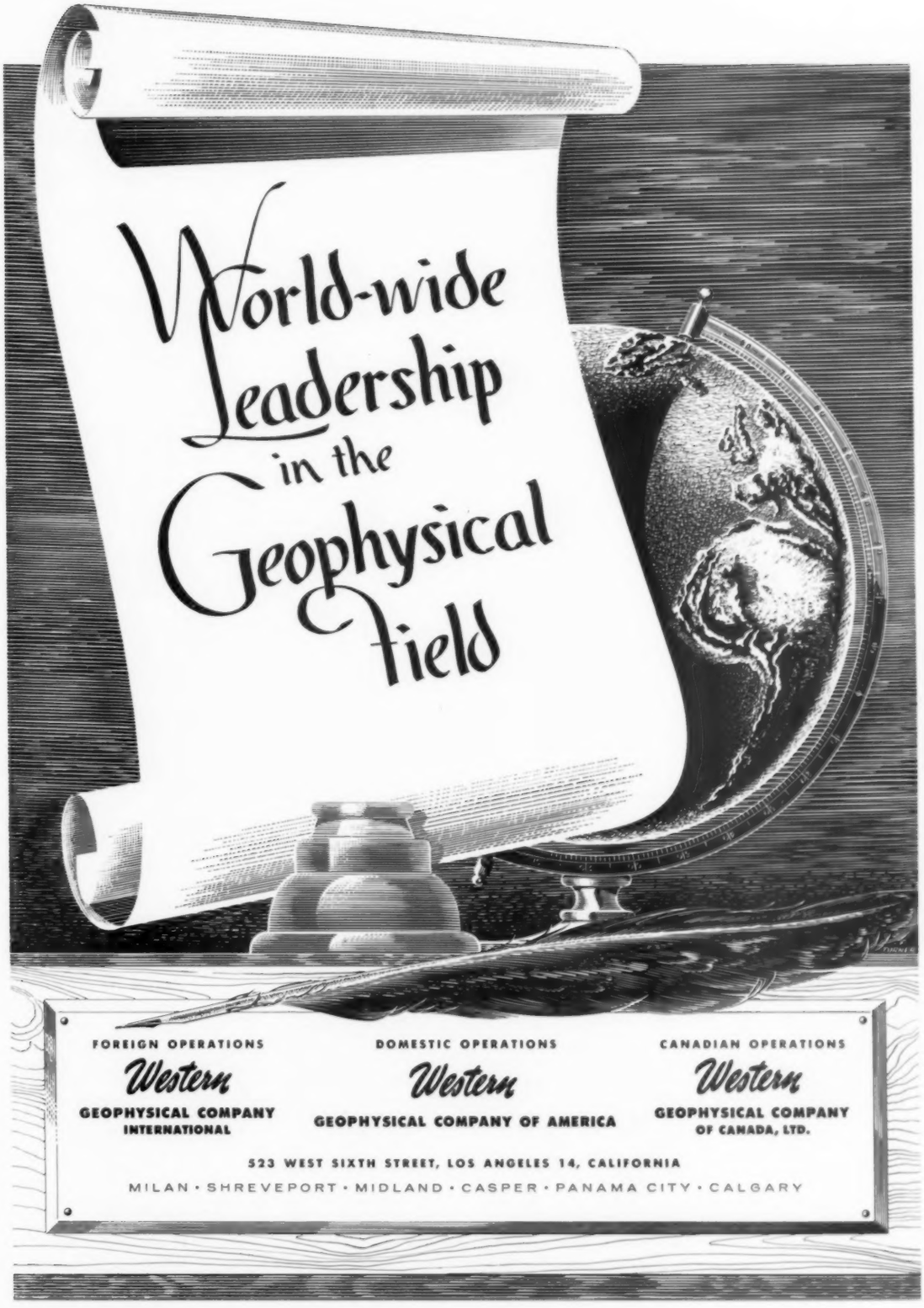
Although the "Blue Demon" Bit you are using has predetermined performance for present drilling conditions, every foot of hole you drill provides a test tube for future product improvement . . . keeping bit performance far advanced of drilling needs.

The Hawthorne gear train turning to the right keeps your Kelly rotating smoothly for faster, more efficient drilling . . . cleaner, more economical hole. Continuing research is one of the intangible differences which keeps Hawthorne leading the way in exploration drill bits.

WRITE FOR ILLUSTRATED CATALOG

HERB J. HAWTHORNE INC.

Cable Address: HAWBIT • P. O. Box 7366 • Houston 8, Texas


World-wide
Leadership
in the
Geophysical
Field
FOREIGN OPERATIONS
Western
GEOPHYSICAL COMPANY
INTERNATIONAL
DOMESTIC OPERATIONS
Western
GEOPHYSICAL COMPANY OF AMERICA
CANADIAN OPERATIONS
Western
GEOPHYSICAL COMPANY
OF CANADA, LTD.
523 WEST SIXTH STREET, LOS ANGELES 14, CALIFORNIA
MILAN • SHREVEPORT • MIDLAND • CASPER • PANAMA CITY • CALGARY

GEORGE WEAR, Houston, has been promoted to the newly created position of general attorney for Continental Oil Co.'s CATC marine region. Formerly an attorney for CATC, he will continue to make his headquarters at Houston. Continental is the operator for the CATC offshore group, which consists of Continental, Atlantic Refining Co., Tidewater Oil Co., and Cities Service Production Co.

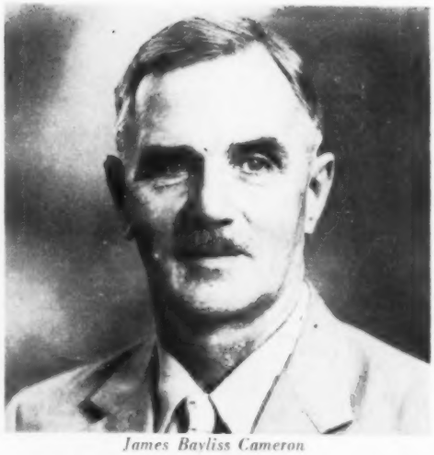
C. L. MERRELL has been promoted to manager of Phillips Petroleum Co.'s foreign department, with headquarters in Caracas, Venezuela, succeeding F. W. Floyd who retires after 12 years with the company and nearly 40 years in the industry.

Mr. Merrell, who joined Phillips in 1946, had held various engineering and supervisory positions in the foreign department since 1949. Previously he had done engineering work in the company's research and development organization. He is a native of Missouri, and received his BS in petroleum engineering from Missouri School of Mines.

WILLIAM M. HOLADAY, formerly head of the research and development activities of Socony Mobil Oil Co. Inc., has left the company, effective February 1, 1957, to become Deputy Assistant Secretary of Defense (Research and Development). Mr. Holaday has been on leave of absence from the company since February 1, 1956, serving in this capacity—with headquarters in Washington, D.C.

J. PATRICK D'ARTOIS has been appointed resident manager in charge of all operations of The Ohio Oil Co. of Guatemala. D'Artois will be responsible directly to F. J. Funk, vice president of the Guatemala organization and manager of foreign production for the Ohio Oil Co. A. H. Petsch has been appointed exploration manager of the organization, responsible for oil and gas exploratory operations.

HARRY H. SISSON has been appointed chief geophysicist for Monterey Oil Co., Los Angeles, Calif.—responsible for company's entire seismic exploration program.



James Bayliss Cameron

JAMES BAYLISS CAMERON, veteran international oil man, has been appointed by Cameron Iron Works Inc., Houston, Texas, as its sales and service representative for New Zealand, Australia, British and Dutch Guinea, and the Philippines. Beginning in the USA oil fields in 1919, Mr. Bayliss has served with Anglo-Persian Oil Co., British Burma Petroleum, Anglo-Iranian Oil, and Shell in Burma, England, Scotland, Trinidad, Egypt, and Australia.

WILLIAM F. KENNEY, of New York, vice president and general counsel of Shell Oil Co., has been elected 1957 chairman of the American Petroleum Industries Committee of the American Petroleum Institute. He succeeds Robert H. Scholl, vice president and director of Esso Standard Oil Co., who has been chairman the past two years. Henry L. O'Brien, of New York, general counsel and director of Cities Service Co., was chosen to succeed Mr. Kenney as APIC vice chairman.

Forms European Subsidiary

Selas Corp. of America, European Division SA, with headquarters in Geneva, Switzerland, has been formed to serve industries in Western Europe. W. Jack Hofmann is general manager and A. E. Baltus is sales manager.

Caughey Made Chief Kellogg Metallurgist

Robert H. Caughey has been appointed chief metallurgist of the M. W. Kellogg Co., New York. He has been assistant chief metallurgist since joining the company in 1946.

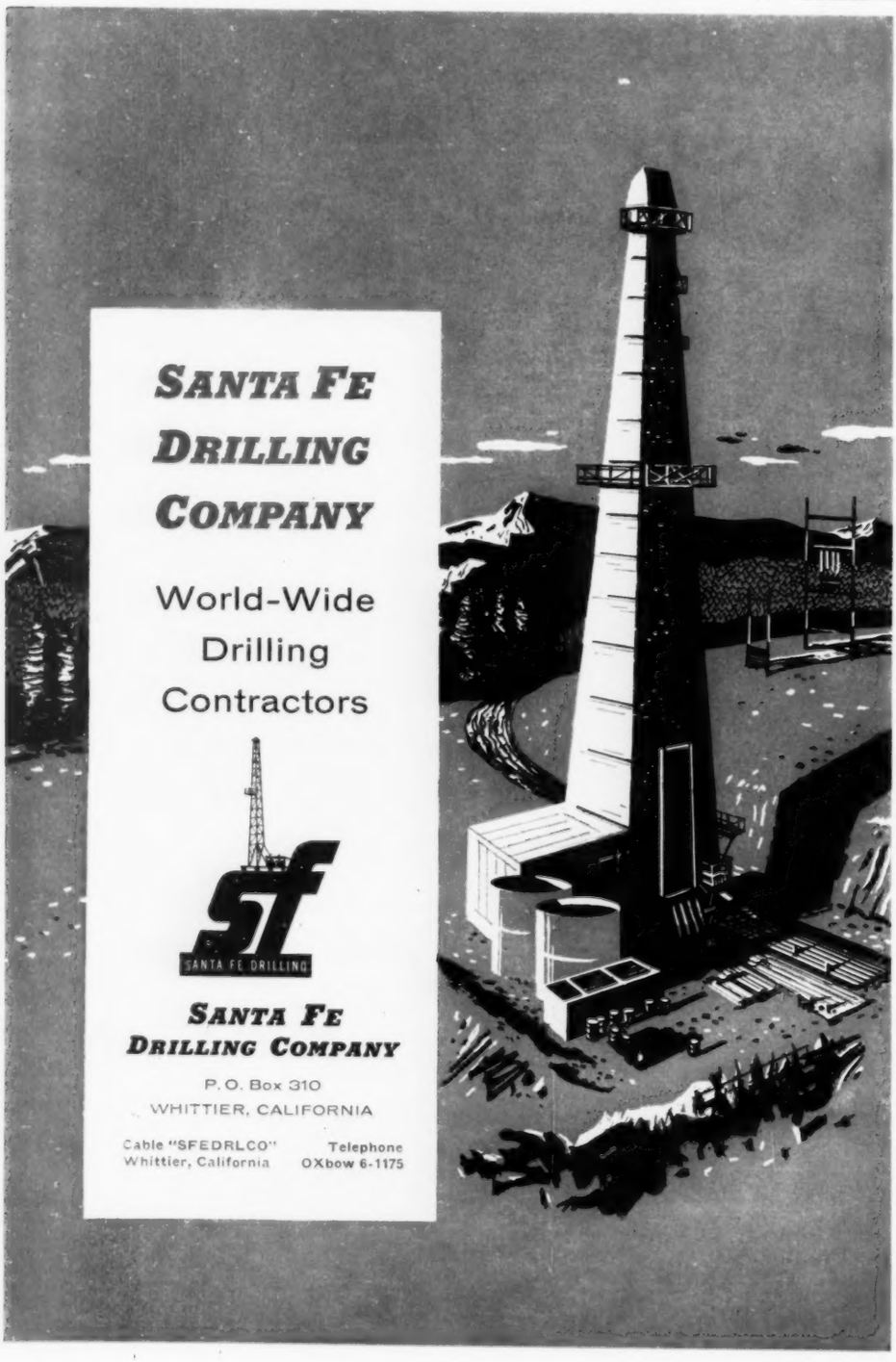
Mr. Caughey has specialized in the evaluation, production, and fabrication of high-temperature steels for more than 20 years. At Kellogg, he has been closely connected with the development of the stainless steels for high-pressure and temperature power piping. He succeeds Harry S. Blumberg in his new position, the latter retiring to become a metallurgical consultant.

Jones Represents Business Development

Arthur C. P. Jones, attached to the assistant general manager's department of the Bank of Montreal in Vancouver for the past year, has been appointed a special representative of the bank's business development department, with headquarters at Calgary. He will work with C. A. P. Leahey, special representative, in the bank's development operations in the oil fields of Alberta.

Tidewater Refinery Appointments

Tidewater Oil Co. has announced 9 supervisory appointments at new Delaware Flying "A" refinery, near Wilmington, Del.: Leroy V. Scott is supervisor of employee relations; Raymond K. Arzinger, technical foreman, utilities and sulfur-recovery area; Charles H. Bennett, unit technical foreman, cracking area; William W. Burleigh, unit technical foreman, desulfurizing and hydrogen area; William J. Doyle, Jr., unit technical foreman, crude area; Laurance A. Gleason, technical foreman, alkylation-polymerization area; Edwin J. Hoffman, unit technical foreman, coking area; Glenn W. Wimberly, unit technical foreman, reforming and extraction area; and R. E. Lumpkin, a general coordinator.



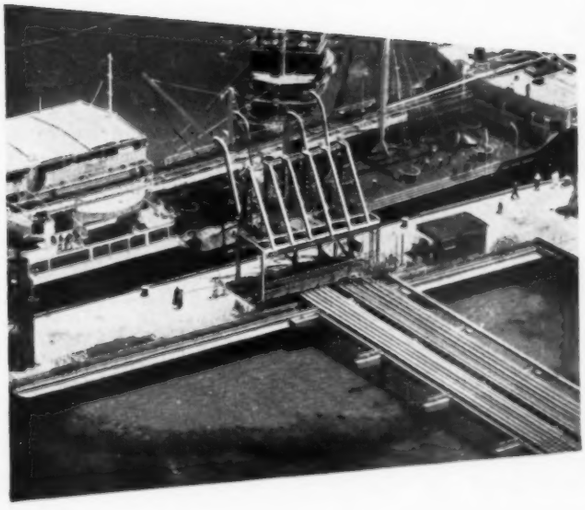
Speedier turn round at:—
Right : Aden Refinery.

Below right : Kent Oil Refinery, Isle of Grain.

Bottom : Kwinana Refinery, Australia.

WOODFIELD
HOSE HANDLING
Equipment

Saves Hose Costs, Labour and Demurrage charges, at many of the World's Refineries, Oil Storage Depots and Docks



WOODFIELD HOIST
AND ASSOCIATED INDUSTRIES LIMITED

FRINDSBURY WORKS · ROCHESTER · KENT

Telephone: STROOD 78421 (5 lines) Telegrams: WOODFIELD ROCHESTER TELEX: 26-2117 WOODFIELDSTROOD

LONDON OFFICE: 147, Victoria Street, S.W.1.
Telephone: TATe Gallery 4135 (3 lines)

Incorporating the Kemworthy Jig & Press Tool Company · London

10922

L. G. RODGERS of Tulsa, Okla., has been appointed to the staff of the Office of Oil and Gas of the Department of the Interior. Mr. Rodgers will be responsible for OOG programs involving refining, synthetic fuels, and natural gasoline. He graduated in 1939 from the University of Tulsa in petroleum refining engineering, and later worked with Ashland Oil and Refining Co., Stanolind Oil and Gas Co. in 1946 as an engineer, and with the Sunray Mid-Continent Oil Co.

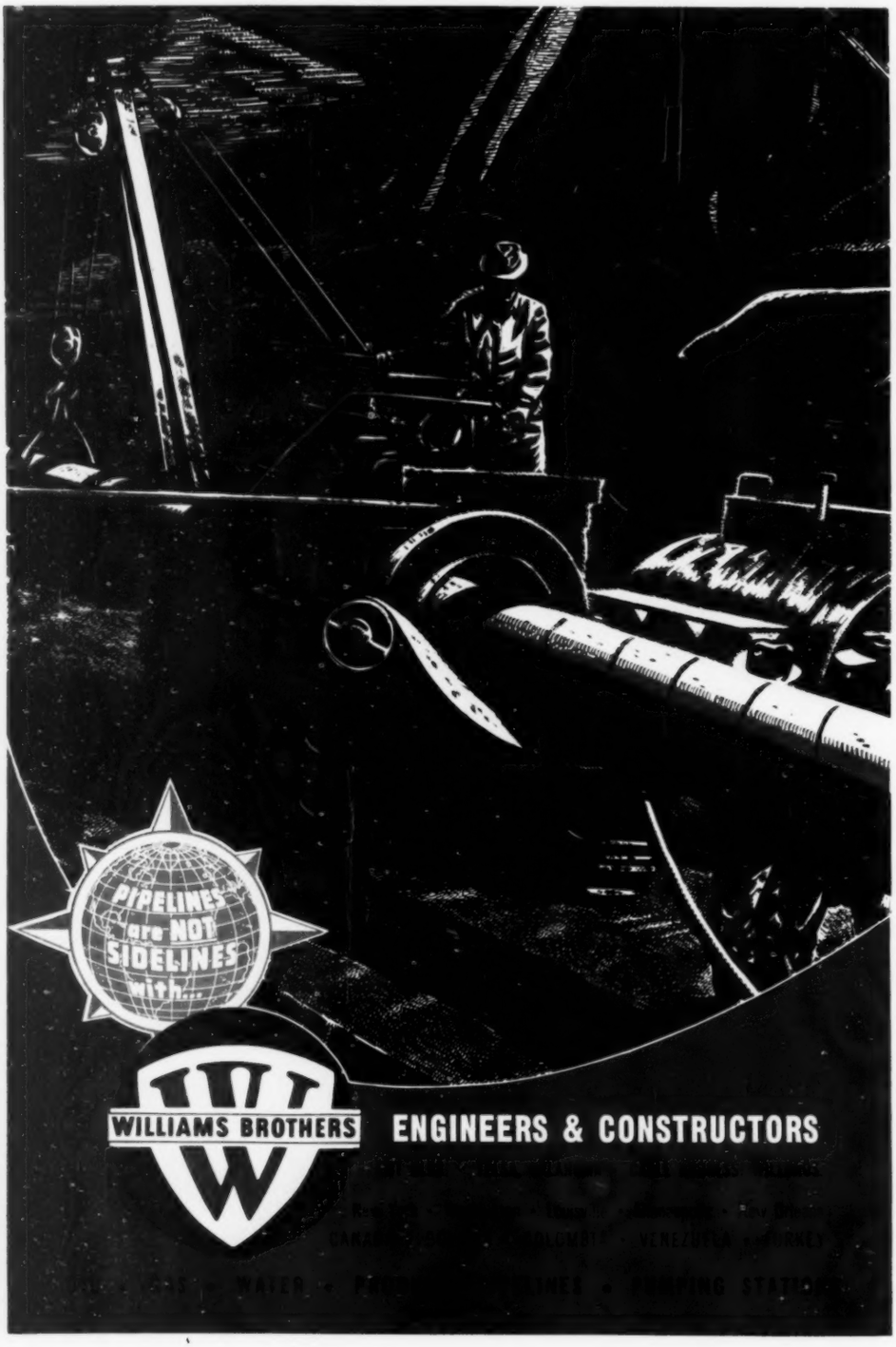
HUGH MILLER, former president of the Corpus Christi Refining Co. and for 17 years general superintendent of refineries for Phillips Petroleum Co., has joined Kerr-McGee Oil Industries Inc., as manager of the company's Wynnewood, Okla., refinery.

ARTHUR I. COYLE has joined the drilling-mud sales staff of Minerals & Chemicals Corp. of America, Menlo Park, N. J.—with headquarters in Houston.

PAUL FUENNING has changed position from administrative geologist, Geophoto Services, Denver, Colo., to chief geologist, Geophoto Services Ltd., Calgary. He joined Geophoto in 1946, and is the firm's senior employee in terms of service.

A. D. DUNLAP, associated for 23 years with Independent Exploration Co., recently was made director of operations for IX, Houston, Texas. Before his promotion he was manager of Independent Exploration's Canadian branch.

HOWARD H. HINSON has been elected vice president and general manager, Exploration Department, Continental Oil Co., Houston, Texas—assuming domestic and Canadian exploration duties. S. K. Clark, for 32 years in the exploration and foreign departments, becomes Mr. Hinson's assistant. W. C. Stout becomes manager of the headquarters land section, in Houston.



Phil Thomas

PHIL THOMAS recently was appointed to the newly created position of export sales representative of the Export Division, Magnet Cove Barium Corp.—with headquarters in Houston, Texas. He will be responsible for contacting users of drilling muds all over the world. Much of his early efforts will be toward the development of Magcobar sales in South America.

C. E. EVANS, OBE, has been appointed general manager of British Hydrocarbon Chemicals Ltd., at BHC head office in Devonshire House, London. BHC Ltd. is owned jointly by British Petroleum Co. and The Distillers Co. Ltd.

D. BLAIR WATT has been appointed works manager at Grangemouth, where Mr. Evans was manager from 1951 until his recent promotion.

C. J. LOCKWOOD, a director and executive vice president of Socony Paint Products Co., Metuchen, N.J., has been elected president. He succeeds Sanford G. Lansing, retiring after 21 years.

ROBERT M. KOPPENHOEFER has been elected a director and vice president of Socony Paint Products, wholly owned subsidiary of Socony Mobil Oil Co. Inc.

HENRY L. WASZKOWSKI has become assistant to the manager of Socony Mobil Oil Co.'s producing department in New York.

MALCOLM T. McCANTS has opened his new consulting engineering offices in the Texas National Bank Bldg., Houston, mainly for the petroleum and petrochemical industries. Formerly he was plant manager for Great Northern Oil Co., St. Paul, Minn., and had designed and erected refineries in the Southwest.

FRANK RICHARDSON has been appointed manager of the production and exploration department of Lion Oil Co., a division of Monsanto Chemical Co., and assistant to J. E. Howell, Lion vice president in charge of production and exploration. Mr. Richardson has been assistant to Mr. Howell.

WILLIAM W. CLAWSON, former Magnolia Petroleum Co. geologist, has been named coordinator of domestic production and a member of the producing committee of Socony Mobil Oil Co. Inc., New York. Since 1952, Mr. Clawson has served as president of Mobil Producing Co. and Mobil Oil of Canada Ltd.—both exploration and producing affiliates.

RUSSELL D. RICHARDSON has been elected treasurer of Tidewater Oil Co., San Francisco, in addition to his present responsibilities as controller.

HUGH B. HODGES, retired Tulsa drilling contractor and independent producer, has been elected a director of Sunray Mid-Continent Oil Co., Tulsa, Okla. Mr. Hodges takes the board position recently vacated by James K. Ellis, San Antonio, who became a director of Suntide Refining Co., Corpus Christi, a Sunray affiliate.

ARTHUR J. HELMBRECHT, vice president, has been elected a director of The Buckeye Pipe Line Co., New York, has been announced.

Jenkins of ROTHERHAM

Welded

★ Mild steel atmospheric column, 54'0" high x 5'0" dia., ⅝" shell, 9/16" ends, with internal trays. Designed and constructed in accordance with API-ACME Code. Tested 200 lbs. per sq. inch hydraulic.

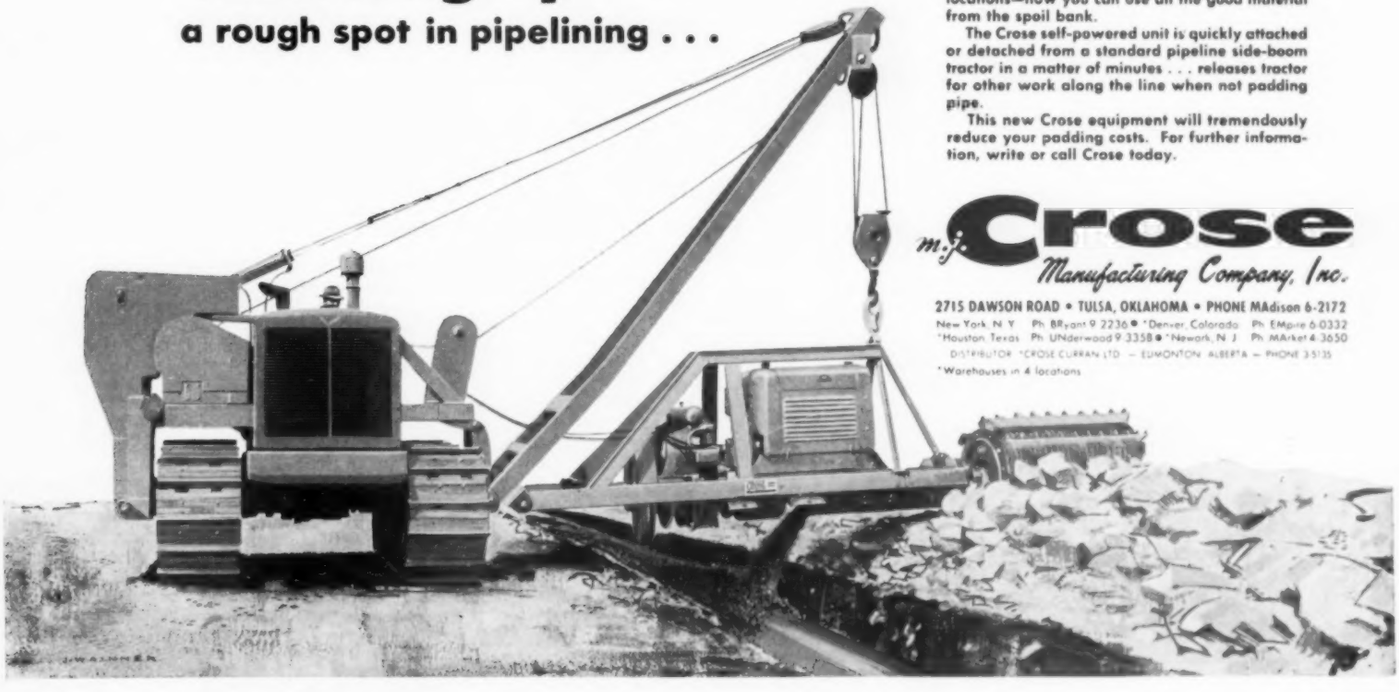
The Ivanhoe trademark identifies the craftsmanship and dependability of Jenkins-welded equipment. Pipe work, tanks, atmospheric and fractionating columns, condensers, pressure vessels, are typical examples of the fabricated welded work we are producing to Class 1 standard.

Robert Jenkins & Co. Ltd.
ESTABLISHED 1856
ROTHERHAM

Telephone: 4201-6 (6 lines)

THE **NEW** CROSE PIPELINE **DITCH PADDER**

softening up
a rough spot in pipelining . . .



Forward Thinking Crose Engineering has produced another machine to reduce pipeline construction costs! This ditch padder has a screening head and conveyor that completely pads coated pipe with selected soft, rock-free soil. Sharp, pipe-damaging rocks are eliminated. No longer must padding material be hauled in from distant locations—now you can use all the good material from the spoil bank.

The Crose self-powered unit is quickly attached or detached from a standard pipeline side-boom tractor in a matter of minutes . . . releases tractor for other work along the line when not padding pipe.

This new Crose equipment will tremendously reduce your padding costs. For further information, write or call Crose today.

m.j. Crose
Manufacturing Company, Inc.

2715 DAWSON ROAD • TULSA, OKLAHOMA • PHONE MAdison 6-2172

New York, N.Y. Ph. BRyant 9-2236 • *Denver, Colorado Ph. EMpire 6-0332
*Houston, Texas Ph. UNderwood 9-3358 • *Newark, N.J. Ph. MArket 4-3650

DISTRIBUTOR *CROSE CURRAN LTD. — EDMONTON, ALBERTA — PHONE 35135

*Warehouses in 4 locations

John Paul Jones

CHARLES F. HUNKINS has been appointed assistant vice president of the oil development department, Northern Pacific Railway. Formerly he was manager of geology and engineering.

EDWIN VAN DEN BARK has been named manager of the southwest region for Phillips Petroleum Co., Bartlesville, Okla.; and **H. D. BROOKBY** is now manager of the foreign department.

JOHN S. FREEMAN, after 34 years of service with the company, has been elected president of Skelly Oil Co., Tulsa, succeeding William G. Skelly, now chairman.

CLAUDE L. BLACKSHER has been named manager of production for Skelly Oil Co., Tulsa.

JOHN PAUL JONES, chief, industrial relations for the manufacturing department of The Standard Oil Co. (Ohio), Cleveland, started a two-year loan assignment in mid-February as assistant to the manager of employee relations for the Iranian Oil Exploration and Producing Co. and the Iranian Oil Refining Co. at Teheran, Iran.

V. C. Georgescu

V. C. GEORGESCU, assistant coordinator of the worldwide producing activities of Standard Oil Co. (New Jersey), has been appointed associate London-Middle East representative. He will serve on the staff of P. J. Anderson, recently appointed to the newly created position of London-Middle East representative.

Mr. Georgescu has actively followed operations in the Middle East since 1949, and in 1954 became a vice president and director of Near East Development Corp., a Jersey Standard affiliate, which owns an interest in Iraq Petroleum Co. and associated companies. Since 1954 he has closely followed the Iran operations in which Jersey has a 7% interest.

JAMES WESLEY YARBRO has joined Texas Pacific Coal and Oil Co. as comptroller, at Fort Worth, Texas.

CHARLES A. SCHRADER has been named vice president for supply and transportation at Leonard Refineries Inc., Alma, Mich., according to Reid Brazell, president.

DR. ENVER NECDET EGERAN has been appointed assistant to the manager of Mobil Exploration Mediterranean Inc., Socony Mobil Oil Co.'s Turkish producing affiliate. He came to Mobil Exploration Mediterranean from the Turkish government, where he had served as vice president of the Petroleum Administration. A native of Cyprus, Dr. Egeran was educated in Cypriot, Turkish, and French schools.

RICHARD V. HOLLINGSWORTH, of the Paleontological Laboratory, Midland, Texas, will become president of the Society of Economic Paleontologists and Mineralogists on April 4, 1957.

J. E. VAETH, veteran oil man and executive vice president and a director of Southern Production Co. Inc., until the acquisition of its oil and gas properties by Sinclair Oil & Gas Co., has resigned from an executive position with Sinclair to become an independent oil operator, with headquarters in Houston.

WAYNE E. SWEARINGEN has been elected vice president of Alex W. McCoy Associates Inc., Tulsa-based geological consulting firm with offices also in Denver, Colo., Casper, Wyo.; and Calgary, Alberta. Dr. Carl Moritz, executive vice president, has been appointed chief geologist.

KARL T. FELDMAN of Sinclair Pipe Line Co., Independence, Kans., has been elected a member of the Platte Pipe Line Co., Kansas City, Mo.

EDWARD W. LANG has been elected vice president in charge of sales of Cities Service Oil Co. (Pa.), principal operating subsidiary of the Cities Service system in the Atlantic Coast area. He also was elected a member of the board of directors.

Other new board members elected were Thomas F. McGarey, vice president, the asphalt department; and Henry L. O'Brien, general counsel of the parent Cities Service Co. As directors, they succeed three retired officers, former president H. E. Brandli, former vice president John D. Morgan, and former treasurer Walter W. Martin.

Koenig ALL-STEEL CABS for JEEPS

FULL AND HALF CABS

KOENIG ALL-STEEL CABS HAVE THESE SUPERIOR FEATURES:

- Protection—Complete protection in all kinds of weather . . . valuable cargo protected by locks.
- Safety—All-steel, welded construction. No rivets . . . safety glass throughout.
- Comfort—Full panel-board head lining and masonite door lining . . . no vibration.
- Convenience—Roll-down windows, full opening.

KING WINCHES

King Winch on R-140 and R-160 International

P.T.O.-driven King Winch on Willys Jeep *

KING WINCHES FOR KING-SIZE PULLING JOBS

. . . on Willys Jeeps, 4 x 4 trucks and station wagons, International, GMC, Chevrolet, Ford, Land Rover, Unimog and other vehicles.

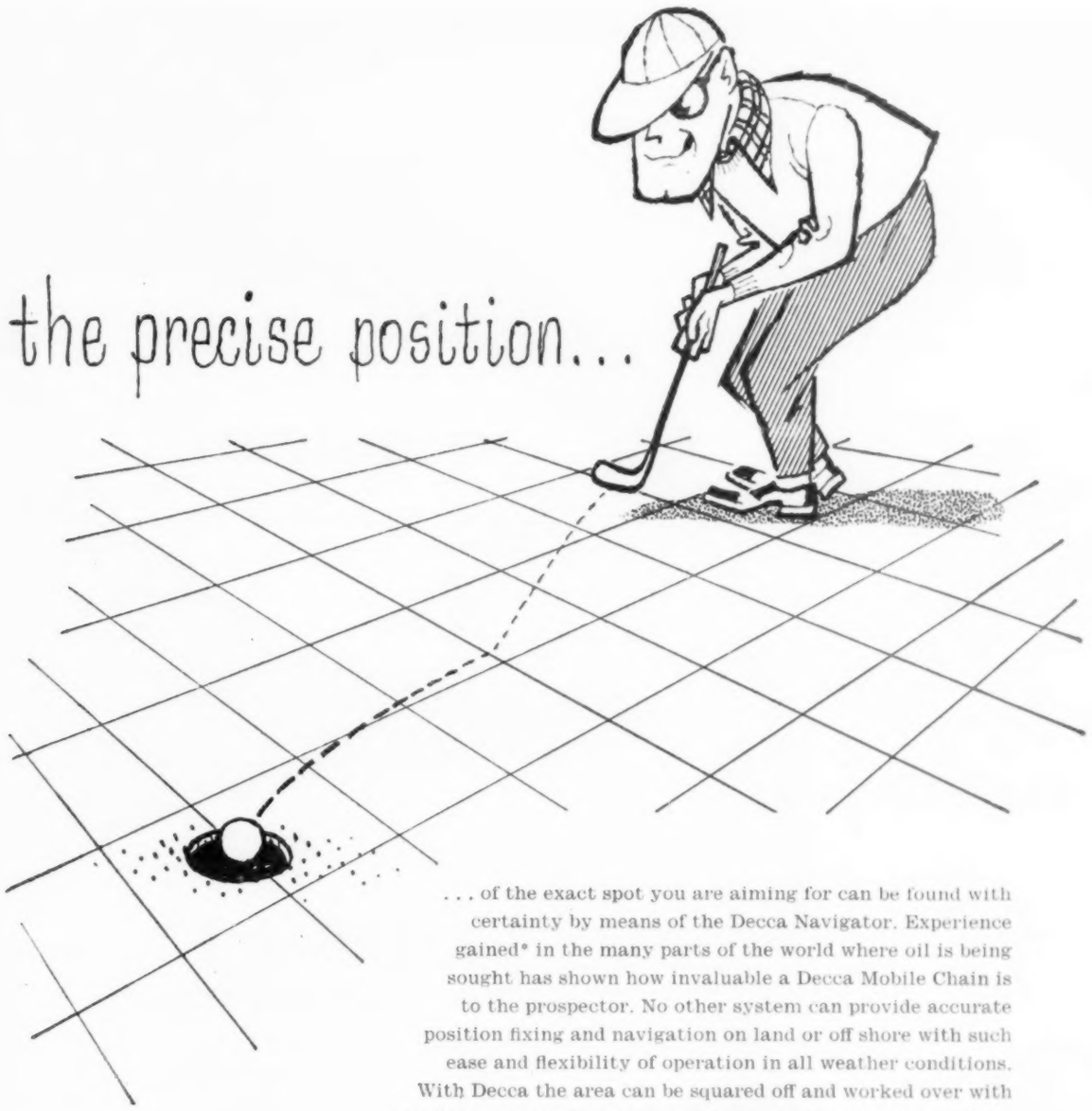
King Winches keep you moving through the most difficult terrain . . . you get action where there's no traction with dependable pulling power. King power winches have pulling capacities of 8,000 to 19,000 lbs.

*POWER-TAKE-OFF-DRIVEN KING WINCH MODELS 130J and 131J for CJ-3B and older-model Jeeps, can be transferred to CJ-5 and CJ-6 Jeeps—NOTHING EXTRA NEEDED.

Koenig Jeep cabs and King Winches for Willys vehicles are available through Willys Motors, Inc., and Willys-Overland Export Corp. distributors or dealers. Write for free descriptive literature.

Koenig IRON WORKS, Inc.

WEST 12th and ELLA BLVD. • HOUSTON 7, TEXAS



. . . of the exact spot you are aiming for can be found with certainty by means of the Decca Navigator. Experience gained* in the many parts of the world where oil is being sought has shown how invaluable a Decca Mobile Chain is to the prospector. No other system can provide accurate position fixing and navigation on land or off shore with such ease and flexibility of operation in all weather conditions. With Decca the area can be squared off and worked over with precision—no portion being omitted and none gone over twice—thus enabling a greater area to be covered in a given time. The position of salt domes or other features meriting further examination can be pin-pointed with absolute certainty, and returned to unerringly at any time. The consequent savings in time, manpower and fuel, are considerable. A single Decca Mobile Chain with its wide-area coverage can be used with equal facility by ship, aircraft or truck.

**Decca Chains are in current operation in every type of climate and terrain from Newfoundland to New Guinea.*

THE DECCA NAVIGATOR

Mobile Chains for Survey and Exploration

THE DECCA NAVIGATOR COMPANY LIMITED, LONDON, ENGLAND

KETJEN

AMSTERDAM

Catalyst Division

KETJENFORM

m.s. fluid hydroforming catalyst

KETJENCAT

m.s. fluid
cracking
catalyst

KETJENFINE

HYDRO-DESULFURIZATION CATALYST

Ketjenfine, the catalyst with
the highest activity on weight-basis.
Bulk density: 42 lbs per cubic foot.
Available in pellets of 3/16" and 1/8".

Apply to:

NEDERLANDSCH VERKOOPKANTOOR
voor CHEMISCHE PRODUCTEN N.V.

Amsterdam - Holland - 63 Mauritskade
P.O.B. 4038 - Telephone 54322 - Telex 12270 - Telegrams: Chemicals

KJ-4-13E

WORLD WIDE EXPLORATION FOR PETROLEUM

6200 East Forty-first Street In Tulsa

SSC's New international headquarters...
with the most modern facilities...
for conducting world-wide exploration...
wherever oil must be discovered...

Our 26th Year

WORLD-WIDE SUBSIDIARIES

• SSC of Canada • SSC of Colombia • SSC of Mexico • SSC of Bolivia
• SSC of Venezuela • SSC International • Seismograph Service Limited of England
• Seismograph Service Italiana • Compagnie Francaise De Prospection Sismique

Seismograph Service Corporation P.O. BOX 1590, TULSA, OKLAHOMA, U.S.A.

SEISMIC — GRAVITY AND MAGNETIC SURVEYS — LORAC — CONTINUOUS VELOCITY LOGGING

International Oil Intelligence
as contained in

WORLD PETROLEUM REPORT

Need your oil news fast, accurate, compressed? Truly international in scope, to match an international industry? The international oil newsletter

WORLD PETROLEUM REPORT

offers the following advantages:

1 It compresses the oil news, saves you time, packs all the news in four pages with no extraneous material;

2 Coverage is primarily *international*—and more international news is contained than in any other source;

3 Airmailed, it arrives anywhere in the world within a few days of publication;

4 Every year an annual summary of oil events is mailed free to subscribers.

These are only a few of the advantages of WORLD PETROLEUM REPORT, the airmailed oil newsletter. It may be received free, without any obligation, for two months on a trial basis. Just address your order or request for a trial subscription to:

WORLD PETROLEUM REPORT
604 Fifth Avenue, New York 20, New York

"EQUITY" standards to serve you

CREW BOATS. 32'-38'-51'. All Steel. Speeds to 36 m.p.h.

MODERN 250' DIESEL Electric Drill Tender. Shown on Location.

OFFSHORE SUPPLY VESSELS. 124'-130'. Various Arrangements.

TUGS
45'-55'-66'-85'-105'
STANDARDS

Wire, Write or Phone Today for full Details

EQUITABLE EQUIPMENT CO., INC.

DEPT. I • 410 CAMP ST. • NEW ORLEANS 12, LA., U.S.A.

IN MEXICO...

As In Other Oil-Rich Free-World Countries

The GEOLOGRAPH RECORDER

Shows *Where* to Look for Oil!

Yes, Geolograph — the original mechanical well logger — is now in use in oil fields throughout the world. Geolograph's policy of continuous research, both in the factory and field, maintains it as the **most rugged and versatile** well logging instrument available for use **while the well is drilling.**

NOW AVAILABLE FOR EXPORT SALE
(except in Canada)

Geolograph's exclusive "TRIP ACTION" records any down time which occurs while a round trip is being made!

THE GEOLOGRAPH COMPANY

MANUFACTURERS • EXPORTERS

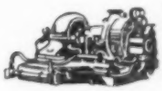
27 N.E. 27TH • P.O. BOX 1291 • OKLAHOMA CITY 1, OKLA.

BROTHERHOOD

VERTICAL AND HORIZONTAL

STEAM TURBINES

FOR DRIVING PUMPS, ETC.



Wide range—All types. Over 50 years' experience. **Hundreds in hand — thousands in service.**

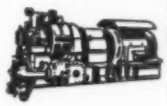
BROTHERHOOD

COMPRESSORS

Air, Gas and Refrigerating. The widest range in the British Empire — made to suit your requirements. **Thousands in service.**

BROTHERHOOD

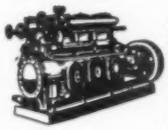
GENERATING SETS



Turbine driven up to 11,000 KW. Engine driven up to 340 KW. **Scores in hand, hundreds in service.**

BROTHERHOOD

REFRIGERATING PLANT



Ammonia, CO_2, Freon, Methyl Chloride, SO_2. Wide range — single and double acting — one or more stages. **Made to measure for special duties.**

also Manufacturers of all kinds of

PLANT TO CUSTOMERS' OWN DESIGNS

WHY NOT SEND YOUR PROBLEMS TO US?

We shall be pleased to investigate them confidentially without commitment

BROTHERHOOD
PETERBOROUGH ENGLAND
COMPRESSOR & POWER PLANT SPECIALISTS FOR NEAR ... EXPORT

Executive Changes at Brown Drilling

Top-level personnel changes have taken place at Brown Drilling Co., with the elevation of E. C. Brown, founder of the company, from president to chairman of the board. R. V. Towner has been appointed to succeed Mr. Brown as president.

Mr. Brown organized his company in 1937, with 18 employees and a rented drilling rig. Today the company's operations extend from Turkey to New Zealand, from Trinidad and Venezuela to the submerged tidelands of offshore California.

Mr. Towner started with Brown Drilling Co. in January of 1948 as office manager and accountant.

E. C. Brown

R. V. Towner

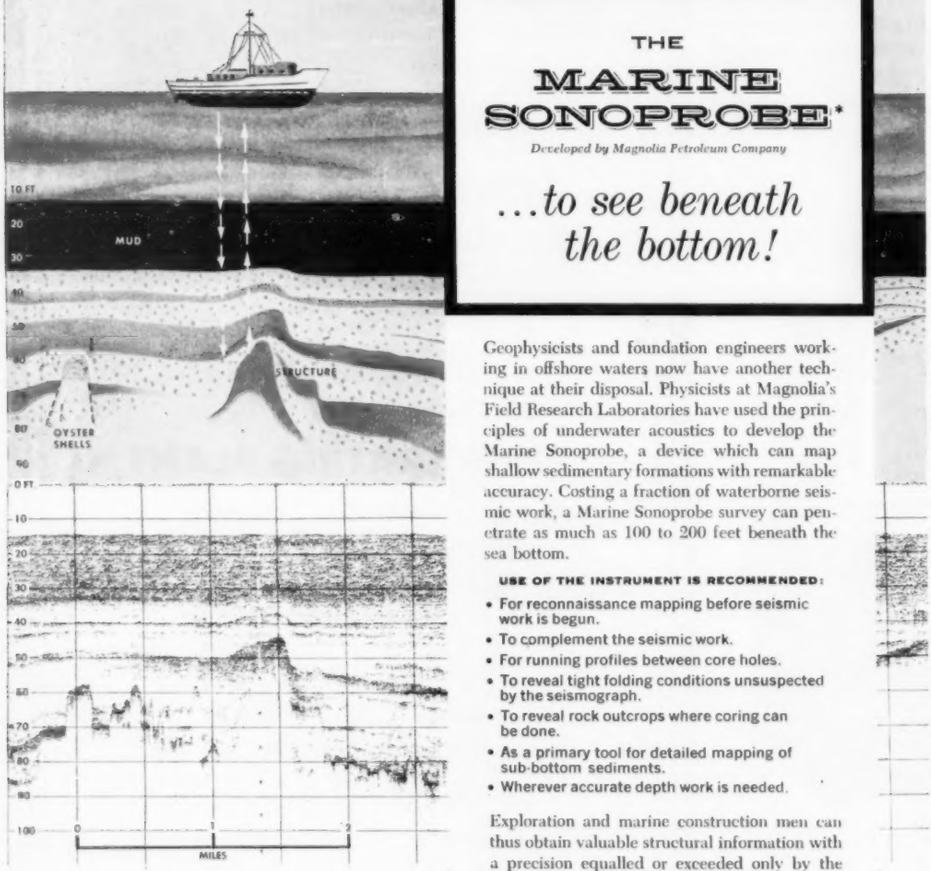
Erratum

S. K. McCauley is not general manager of the manufacturing department of The Atlantic Refining Co., as was stated in our January issue. He is now manager of Iran Atlantic Co., as stated previously, and he will assist in activities of the crude-oil purchases and sales departments of the parent company.

Creates New Executive Posts

Fluor Corp., Ltd., Los Angeles engineering and construction firm, has announced the promotion of two executives to a newly created position of manager of projects. These are: J. L. Tathwell and F. G. Crawford. These posts were created to strengthen the management direction of Fluor projects.

ANNOUNCING... A MAJOR NEW GEOPHYSICAL ADVANCE



THE MARINE SONOPROBE*

Developed by Magnolia Petroleum Company

...to see beneath the bottom!

Geophysicists and foundation engineers working in offshore waters now have another technique at their disposal. Physicists at Magnolia's Field Research Laboratories have used the principles of underwater acoustics to develop the Marine Sonoprobe, a device which can map shallow sedimentary formations with remarkable accuracy. Costing a fraction of waterborne seismic work, a Marine Sonoprobe survey can penetrate as much as 100 to 200 feet beneath the sea bottom.

USE OF THE INSTRUMENT IS RECOMMENDED:

- For reconnaissance mapping before seismic work is begun.
- To complement the seismic work.
- For running profiles between core holes.
- To reveal tight folding conditions unsuspected by the seismograph.
- To reveal rock outcrops where coring can be done.
- As a primary tool for detailed mapping of sub-bottom sediments.
- Wherever accurate depth work is needed.

Exploration and marine construction men can thus obtain valuable structural information with a precision equalled or exceeded only by the core drill itself.

*Trademark

Now available to the oil and construction industries through

FAIRCHILD AERIAL SURVEYS, INC.

LOS ANGELES 15: 224 East Eleventh Street
NEW YORK 20: 30 Rockefeller Plaza
CHICAGO • ATLANTA • LONG ISLAND CITY • TALLAHASSEE • BOSTON SHELTON, WASHINGTON • GENEVA • BRUSSELS • ANKARA • BOGOTA LIMA • VANCOUVER • TORONTO • HAVANA • CARACAS • SANTIAGO GUATEMALA CITY • RIO DE JANEIRO • BUENOS AIRES

Aluminum for Portable Rig

Franks Division of Cabot Shops Inc., Tulsa—in conjunction with Reynolds Metals Co.—has developed a telescoping derrick and its accessory well-servicing equipment, virtually all-aluminum. Weighing about one-third less than an all-steel unit of similar capacity, it offers a solution to the problem of transporting such equipment over public highways.

The unit has been delivered to Phillips Petroleum Co., which plans to put it into operation at Vernon, Texas. Total height of derrick assembly is 68 ft; the folded length is 42 ft 4 in. The unit's operating live capacity is 100,000 lb.

Chicago Corp. Changes Name to Champlin

The Chicago Corp. of Fort Worth, Texas, will now be known as Champlin Oil and Refining Co. Reason for the change is more closely to identify the company's position in the oil industry as a fully integrated oil and gas company. Formed late in the 1920's, Chicago Corp. was formed as an investment trust, and entered the oil and gas business in 1938. In recent years the firm's most significant move was the purchase in 1954 of Champlin Refining Co., Enid, Okla.

California Standard Plans Record Capital Outlays

Standard Oil Co. of California plans a record outlay in 1957 of more than $400 million for capital and exploratory purposes in the Western Hemisphere, according to Chairman R. H. Follis. He reported 1956 expenditures for these objectives reached approximately $356 million, the company's highest up to this time.

Socony Counsel Scott Appointed to APIC

John J. Scott, associate general counsel of Socony Mobil Oil Co., has been appointed a member of the American Petroleum Industries Committee. He succeeds Austin T. Foster, former Socony general counsel, who served as an APIC member since June 1948.

Seismic Data from the Dragon's Mouth!

In 136 A.D., Choko, a Chinese thinker and scientist of the time, constructed the first seismograph in an effort to learn more about dreaded earthquakes. Choko used a sphere with eight openings, ornate dragon mouths, placed evenly around the circumference. Earth vibrations would knock small balls through the opening most closely associated with the direction from which the earthquake wave was traveling into the mouth of a ceramic frog. With this method, Choko was able to obtain some idea of both the direction and magnitude of earthquake waves.

To show how advanced Choko's thinking was, nearly sixteen hundred years elapsed before De Haute Feuille (1703) developed a similar principle. This Frenchman used a half sphere with a bowl of mercury at the top and channels down the side—the passage of earthquake waves caused the mercury to run down a particular channel into a cup.

Now, the most advanced thinking in seismic instrumentation is manifested in the automatic data gathering and reduction systems made by Texas Instruments Incorporated. SEISMATION systems, conceived and developed by TI, streamline the world-wide search for oil!

seisMAC*
Seismic Magnetic Automatic Computer

For free 14" x 9" Choko illustration print suitable for framing, send your request to . . .

TEXAS INSTRUMENTS INCORPORATED
INDUSTRIAL INSTRUMENTATION DIVISION
3609 BUFFALO SPEEDWAY • HOUSTON, TEXAS • CABLE: HOULAB
Formerly: HOUSTON TECHNICAL LABORATORIES

a Seismation system®

*TRADEMARK REGISTRATION APPLIED FOR

6751

Saskatchewan Lease Sale Nets Four Millions

The Saskatchewan government accepted, January 9, cash bonus bids totaling $3,936,330.07 as a result of the biggest oil lease sale yet held in the province. Net royalty bids accepted ranged up to 80.5%.

The January 9 sale saw 254 bids tendered by 32 companies on 50 parcels of crown land amounting to 8,971 acres. Fifteen of these parcels received no bids. Bids on a further seven parcels were rejected.

The Texaco Exploration Co. was the biggest successful bidder at the sale, with bids on 4 parcels in the Kingsford area, totaling $1,492,893. It also was the largest per-acre bidder, offering $2,334 per acre for a 240-acre parcel near the center of the Kingsford field.

Four new oil companies appeared as successful bidders, viz., L-M Oil Co., Regina; Union Oil and Gas Corp., of Louisiana; Triad Oil Ltd., Calgary; and McCarty and Coleman, Billings, Mont.

First Saskatchewan Gas-Injection Project

Saskatchewan Department of Mineral Resources has announced that the Royalite Oil Co. Ltd., has been granted approval to proceed with an experimental natural-gas pressure-maintenance plan in the Coleville area in the southwestern part of the province—first such project in Saskatchewan.

Cities Service Oil Ltd. Elects New Officers

W. Alton Jones has been elected chairman of the board, and Robert J. Hull president, of Cities Service Oil Co. Ltd.—with headquarters in Toronto.

Other officers elected by the board were Burl S. Watson, A. P. Frame, V. E. Sicks, and J. T. McDowell as vice presidents; E. D. Prentis, secretary; and R. A. Price, treasurer.

Western Canadian Oils Outlook Good

Canada will feel the effect of world conditions in oil production and distribution over the long-term future, but the outlook for oil in western Canada remains excellent, according to *Western Canadian Oils—1957*, "blue book" of the Canadian oil industry.

Again in 1956 as in 1955, western Canada exceeded all previous records in exploration, drilling, and production. It was an enormous year for pipelines, "not so much for the amount of money expended during the year or the miles of pipe laid, but because of the number of new projects started that will in the years to come have a very significant effect on the economy of Canada as a whole."

Among outstanding pipeline developments started in 1956 are Westcoast Transmission gas pipeline to take Peace River region gas to the Pacific Coast; Trans-Canada pipeline, which eventually will bring the gas reserves of central and southern Alberta to the highly industrialized regions of Ontario and Quebec; the Westspur oil pipeline, which provides an outlet for southeastern Saskatchewan fields; the Peace River pipeline serving the Sturgeon Lake area fields; the Cremona and Rangeland pipelines, which were constructed to provide transportation for oil both north and south from the rapidly developing fields north and northwest of Calgary. The important extension of the Interprovincial pipeline to Toronto will be a leading event of 1957. Additions to refineries, and new refineries, in the Toronto area, announced in the latter half of 1956, will go into operation in 1958 to raise Ontario capacity to 225,000 b/d—all capable of being served by the Interprovincial pipeline.

New refineries in Washington, before the end of 1958, will bring the export requirements of the Trans Mountain pipeline system to over 250,000 b/d, compared to its present 126,000 b/d. At the end of 1956, British Columbia was using another 60,000 b/d. A steady buildup is visualized in the area of Minnesota, Wisconsin, Michigan, and Ohio; but any possibility of an extension of the Interprovincial pipeline to Montreal, with its daily requirements of more than 200,000 bbl, is considered at least two years away.

Possibility of actual production on the order of 3,000,000 b/d by 1980 is foreseen, with capacity to produce practically in balance with demand. By contrast, current production is indicated as only 61% of capacity. Petroleum will occupy a much larger proportion of the whole Canadian energy consumption market by 1980 with a probable rise to 61.5% from the present 47.6%.

An exhaustive analysis of the Middle East position foresees 200 billion barrels ultimate reserves, with production capacities running to as high as 40,000 b/d for a single well. A survey of world tanker fleets concludes that new construction will not do more than keep pace with increasing demand for ocean shipping for the next few years. For Canada, however, the effect of Middle East crisis conditions is likely to be of minor proportions for the immediate future.

Drilling activity in 1956 was concentrated in the Pembina oil field of Alberta and in southeastern Saskatchewan. Both are expected to dominate 1957 drilling—especially the Saskatchewan region, where wildcat drilling success in 1956 was phenomenally high. Other fields and areas expected to be the scene of great activity in 1957 are the Sturgeon Lake fields, the Rocky Mountain foothills, the Sundre-Westward Ho-Harmattan group of fields, and the Granite Wash play in the far north.

The future of natural gas is going to be determined essentially by the logistics of transportation. The price advantage which gas enjoys over oil at the wellhead is reduced by the distance it has to travel to market. Canadian gas fields are a long way from large market, and the first breakthrough occurred only at the end of 1955 when the Westcoast pipeline was authorized. This line appears destined eventually to supply the whole gas market on the Pacific Coast in both British Columbia and the US.

An estimate of potential consumption of energy in Canada shows the market for natural gas should increase by more than 5 times in the next 25 years, to occupy 13.9% of the total energy market in contrast to 4.9% in 1955. Estimated gas reserves total more than 15½ trillion cubic feet of Alberta alone.

Capital for Canadian oil developments will require some $16 billion over the next 20 years.

THE FLOOR AREA OF OUR NEW OFFICE COVERS 107,214,025,881,600 SQ. FT.

It's quite a large office. It has to be because it covers all of Canada. This is the office of the newly-formed Natural Resources Development Department of Imperial Bank of Canada. From this new office we investigate the potential resource development fields, and gather information and statistics concerning new and established development areas. Mr. R. J. Redrupp, Superintendent of the Natural Resources Development Department, is able to offer financial advice and assistance to businessmen engaged in developing Canada's rich natural resources. He works closely with Mr. A. S. de Rosenroll, Imperial Bank's resident specialist to the oil industry at Calgary, Alberta. This vital new department, first of its kind in a Canadian bank, is another example of Imperial Bank leadership.

IMPERIAL

the BANK *that service built*

IMPERIAL BANK OF CANADA

HEAD OFFICE, TORONTO

McCann Heads Johnston Testers

D. C. McCann has been appointed president of Johnston Testers. M. O. Johnston, founder of the company, and formerly president and chairman, will continue to serve as chairman. Johnson Testers is a subsidiary of Schlumberger Well Surveying Corp.

Mr. McCann has been vice president in charge of field operations for Schlumberger. He is succeeded in that position by Edward F. Stratton.

Tanker Repair Time Cut 73%

General Electric marine repair specialists made emergency repairs in record time on three tankers headed for the Suez Canal Zone. The tankers were repaired in three weeks—cutting usual repair time by 73%. Estimating a tanker's operating value at $10,000 per day, the company says the record repair means a difference of $1,680,000 to the ships' owners if usual repair procedures had been followed.

Stanolind Becomes Pan American Petroleum Corp.

Stanolind Oil and Gas Co. took the name of Pan American Petroleum Corp., as of February 1, 1957.

Change is being made for two reasons: to eliminate any possibility of confusion in the public mind between Stanolind Oil and Gas Co. and other oil companies with names similar to or having a significance similar to the Stanolind name, and to give the Tulsa-based firm a name more indicative of the geographical extent of its operations.

Engineering Department for Ethyl

Formation of a separate engineering department in Ethyl Corp. has been announced by E. L. Shea, chairman. The new department, he says, will encompass the general engineering and construction coordination functions which were formerly a part of the Research and Engineering Department. It will be headed by A. C. Burdick, as chief engineer.

T. N. Shults

Shults Elected Mid-Continent VP

T. N. Shults, manager of Mid-Continent Supply Co.'s export division, has been named vice president-export. He has been in Mid-Continent's export division in New York for the past 10 years, and has been manager of the export division since 1952. He is a veteran in the oil-field supply business, with 19 years' experience—17 years of it with Mid-Continent.

New Otis Head

Robert H. McLemore has been elected president of Otis Engineering Corp., Dallas, Texas, and subsidiaries. H. C. Otis, formerly president and founder of the 30-year-old firm, is now chairman. Parent of Otis Pressure Control Inc., oil-well service subsidiary, Otis Engineering manufactures subsurface tools and equipment for high-pressure oil and gas wells.

Experts to Advise On Oil-to-Europe Problems

To provide adequate representation from all segments of the US petroleum industry and to keep to a minimum possible adverse effects of the oil-to-Europe plan on domestic economy, Interior Secretary Fred A. Seaton has named four additional experts, who will serve without pay, to advise the Office of Oil and Gas regarding problems which may arise in the shipping of American oil to Western Europe during the Suez Canal crisis.

Appointments, made upon recommendation of Hugh A. Stewart, director of the Office of Oil and Gas, are: Glenn E. Nielson, of Cody, Wyo., president of Husky Oil Co. and of Husky Oil and Refining Ltd., Canada; Reid Brazell, of Alma, Mich., president, Leonard Refineries Inc., and president of Western Petroleum Refiners Assn.; Bruce C. Clardy, of Dallas, Texas, independent oil producer and partner of Clardy and Barnett; and William Simon, of Washington, D. C., partner in the law firm of Howrey and Simon, formerly with Petroleum Administration for Defense.

New South American Relief Map

A plastic relief map of South America has been published by Aero Service Corp., 210 E. Courtland St., Philadelphia. The realistic, three-dimensional map is printed in 10 colors, ranging from copper-brown to dark green; dimensions are 41 in. by 54 in. Seven land elevations and four ocean depths are shown. Scale is one inch equals 110 miles. Vertical exaggeration, common to all relief maps to emphasize land forms, is 20 to one.

Gulf Map Theft Subject to Court Action

Gulf Oil Corp. has explained that, if information obtained from the maps stolen from its file have been used to secure oil and gas leases, royalties, or other interests in prospective oil-producing properties, Gulf would sue to recover such properties.

T10 —a new and heavier
ALLEN MOBILE CRANE

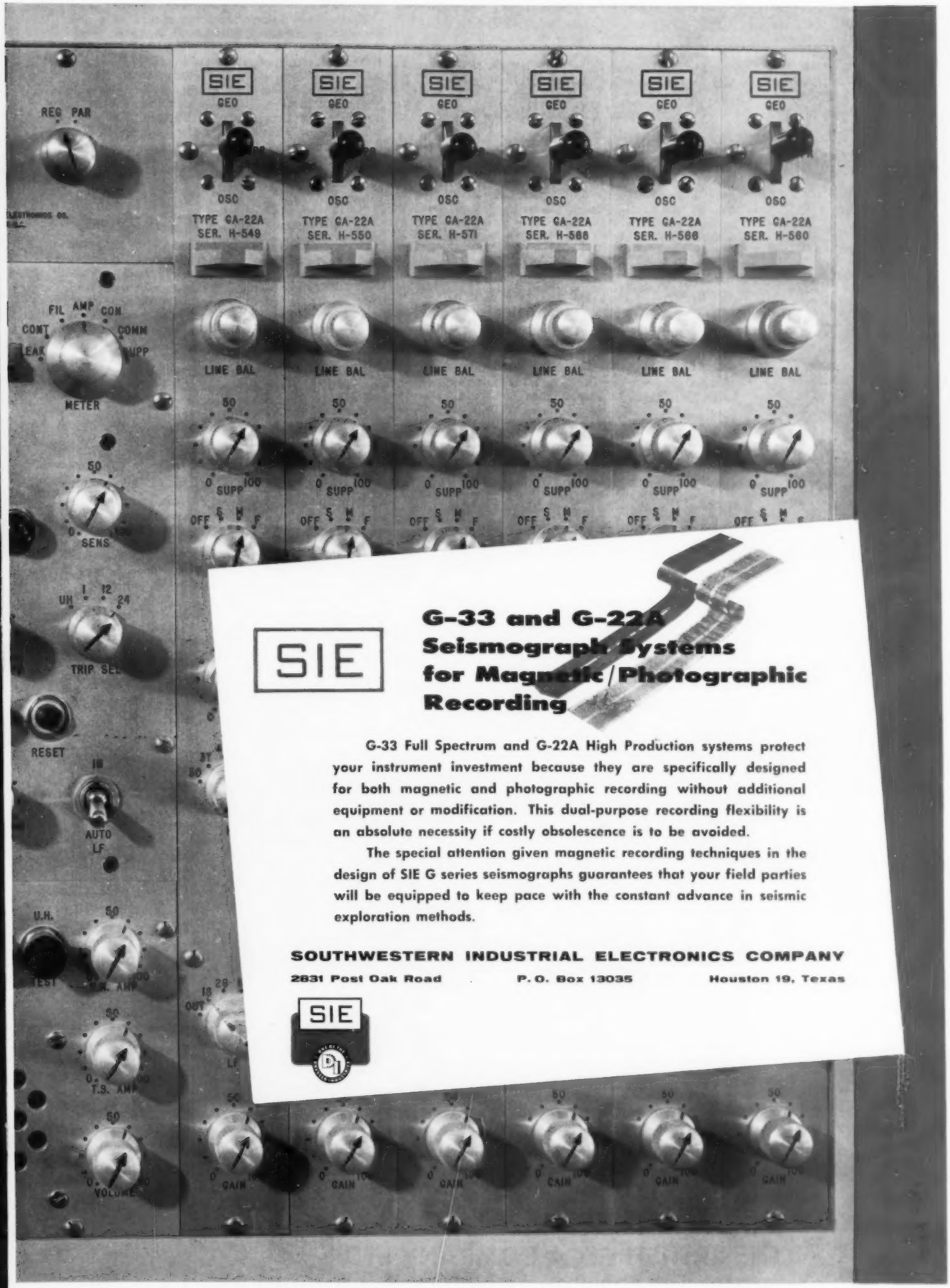
Built to the same high standard as its smaller contemporary —the well-known model K—this new mobile crane excavator will give the same long, trouble-free service, with a much bigger performance.

- Designed and built at Cowley, the six-wheeled chassis is powered by a Gardner 5 L.W. oil engine, giving 94 b.h.p. at 1,700 r.p.m.
- There is a separate power unit (Gardner 4 L.W.) for turntable.
- Using the standard lattice boom the T.10 can be equipped for grab, dragline or crane work.

Please write for full particulars.

JOHN ALLEN & SONS (OXFORD) LTD COWLEY OXFORD ENGLAND

HERE TODAY.... and TOMORROW!
SIE
GEO
OSC
TYPE GA-22A
SER. H-569
SER. H-558
SER. H-565
SER. H-548
SER. H-551
SER. H-581
EXT TEST INPUT
SUPP
AGC
AMP
HF
LF
GAIN
ZERO
OHMS
POWER
ON
OFF
RATE
TRIP
OSC
COMM
TALK



SIE

G-33 and G-22A Seismograph Systems for Magnetic/Photographic Recording

G-33 Full Spectrum and G-22A High Production systems protect your instrument investment because they are specifically designed for both magnetic and photographic recording without additional equipment or modification. This dual-purpose recording flexibility is an absolute necessity if costly obsolescence is to be avoided.

The special attention given magnetic recording techniques in the design of SIE G series seismographs guarantees that your field parties will be equipped to keep pace with the constant advance in seismic exploration methods.

SOUTHWESTERN INDUSTRIAL ELECTRONICS COMPANY

2831 Post Oak Road · P. O. Box 13035 · Houston 19, Texas

SIE

Erratum

Dr. Luis Padilla Nervo was incorrectly identified in the photograph contained on page 53 of our January issue. He is secretary of Foreign Relations in Mexico. In the center of the front row of the notables attending the opening of the 20th International Geological Congress in Mexico City was the president of Mexico, President Adolfo Ruiz Cortines.

Diaphragm Control Valve

Elsey Corp., Bartlesville, Okla., has designed a diaphragm control-valve installation with built-in bypass. Both normal and 3-way installations are available. In either case, the new valve eliminates complicated fabrication and a number of individual valves. The unit is designed so that repair or replacement of valve seats or change from normally open to normally closed position can be accomplished with the valve in the line and operating under pressure.

Dresser Sales Up 35% and Earnings 58%

The continued and steady growth of Dresser Industries Inc., leading suppliers of equipment and technical services for the oil, gas, chemical, and electronic industries, was reported by H. N. Mallon, chairman of the board, and J. B. O'Connor, president, in their 1956 annual report.

Sales for fiscal 1956 were $230,292,000, an increase of 35% over the previous year. This substantial growth in sales had an even more favorable impact upon Dresser's 1956 earnings, which, after taxes, increased by 58%, or up $17,259,000 compared to $10,904,000 in 1955. Sales and earnings for both periods include operations of The Guiberson Corp., acquired August 31, 1956.

Based upon the 2,172,325 shares outstanding as of October 31, 1956, net earnings per common share were $7.94, compared with $5.15 reported upon the 1,991,696 shares outstanding at the end of the 1955 fiscal year. Calculated on the basis of the 2,172,325 shares outstanding in 1956 as a basis of tracing Dresser's growth as it is currently constituted, the 1955 earnings total $4.97 per share.

Royalite Promotes Dent

E. S. DENT of Vancouver, formerly district manager for British Columbia for Royalite Oil Co. Ltd., has been transferred to Calgary as assistant sales manager in the marketing division. D. J. Morgan has been appointed to succeed Mr. Dent.

To Expand Calgary Refinery

Imperial Oil Limited is considering a rebuilding and expansion program at its Calgary refinery which would cost in the neighborhood of $17 million. The company has an option on 260 acres of land, owned by the city of Calgary, adjacent to the refinery. An application for rezoning this land from agricultural to industrial use is now before the city authorities. The company's intention is to double the capacity of the existing refinery and install processing units of the latest type.

To Build Butyl Rubber Plant at Lake Charles

A plant to produce butyl rubber will be built by Petroleum Chemical Inc. at Lake Charles, La. An initial plant capacity of 30,000 tons a year will be installed costing more than $17 million, and that capacity easily can be expanded by 50% at a later date.

The Lake Charles plant will be the first one built since the war. Its operation will increase national productive capacity for butyl rubber by about one-third, and full production may be achieved before January 1959.

General Geophysical Has French Affiliate

General Geophysical Co. further has expanded its foreign operations by establishment of a new affiliate, General Geophysical Co. de France. Manager is Jean Bock, with offices at No. 1 Square Rapp, Paris 7.

General Geophysical, the Houston-based organization, conducts its services from a number of oilfield locations in the USA and Canada.

New Home For Electro-Tech

Electro-Tech International has moved to a new home at 2424 Branard, Houston. H. A. Sears, president of ETI said: "Our new offices provide some 4,000 square feet of office space and 6,000 square feet of laboratory and manufacturing space."

The company plans manufacturing of new seismic instruments, and is setting up a training center for foreign geophysical personnel. The training center will teach the latest techniques and the most effective use of the Electro-Tech seismic equipment. The company has offices in Paris; Rome; Toyko; Cambridge, England; The Hague; and Tuyuga, Calif.

Contractors Drill 93% of Wells

Drilling contractors dug 93% of the 58,281 wells completed in the United States in 1956, according to figures compiled by the American Assn. of Oilwell Drilling Contractors. Contract costs were held at the 1944 level of $4.75 per foot. All other costs rose sharply. Contract price in 1944 was 57% of completion cost, compared with 34% in 1956.

Footage drilled in 1956 totaled 234,250,550, an average of 4,022 ft, compared with 4,044 ft per well in the 56,860 wells completed in 1955. Average number of rotary rigs running in 1956 in both the US and Canada was 2,846, compared with 2,873 in 1955. Peak for the year was 2,998 in June, before activity was cut by strikes and material shortages.

Pakistan Gas Show

Standard Vacuum Oil Co. has struck natural gas at Mari, about 40 miles from Sukkur, and there are bright chances of finding oil in the area. Indications are that the gas will be available commercially.

The gas, it is learned further, was discovered twice during drilling operations at Mari test well in the recent past. First the gas deposits were struck sometime in January after drilling 1,500 ft of well and again at 3,500 ft underneath the earth early in February.

On both the occasions the gas deposits were sealed, and presently the company is proceeding with their drilling operations in search of oil.

BENTONITES
ACTIVATED EARTHS

CLARSOL: High grade drilling bentonites produced from our Algerian mines, processed to rigid specifications and supplied in quantity to major petroleum companies throughout the world.

CLARSIL: Activated earths specifically designed for petroleum refining and available in any quantity and grade required.

CECA Group also manufacture and supply to the petroleum industry a full range of activated carbons, filter aids, insulating kieselguhrs and refractory insulating bricks.

175 PICCADILLY
LONDON · W.1

CECA
THE BRITISH CECA COMPANY LTD.

Telephone: HYDe Park 5131 (5 lines)
Cables: Acticarbon, London

ONE OF THE CECA GROUP OF COMPANIES

Stanolind Oil and Gas Co., Tulsa, headed by E. F. Bullard. In a supplementary change, Pan American

EXECUTIVE INTERIOR APPOINTMENTS

INTERNAL ELECTRIC HOIST OPERATION

QUICK CHANGE FLOAT INSTALLATION

TWO-PATIENT LITTER-KIT INSTALLATION

Presenting the **BELL RANGER**

Versatility Unlimited!

Newest of the famous Bell Model 47 family, the Ranger is truly an all-purpose helicopter with unlimited versatility.

This fast, powerful addition to the Bell fleet defies severe weather and rugged terrain. In a matter of minutes its luxurious executive interior can be converted to cargo carrier, aerial ambulance or rescue conveyance ...its internal hoist can be completely installed in five short minutes.

For the complete story of this great new four-place business aircraft, write, wire or phone...Sales Manager, Dept. JA-5, P. O. Box 482, Fort Worth, Texas.

BELL Helicopter CORP.

FT. WORTH, TEXAS

Subsidiary of Bell Aircraft Corp.

Robert H. Caughey (left) and Waldo McC. McKee present Harry S. Blumberg (right) with retirement gift.

Crude Prices Advance for First Time Since 1953

In the wake of world transportation shortages resulting from the Suez closure, crude-oil prices began an advance worldwide in an effort to meet oil shortages in Europe. First crude price increases in the USA since June 1953 (when the average rise was 50 cents per barrel) occurred early in January 1957. On January 3, Texas API 39-gravity crude rose 35 cents, to a base price of $3.25 per barrel. On January 5, Mid Continent (36-36.9 gravity) crude rose to $3.17 per barrel. Venezuela (Mulata) 36-36.9 gravity crude is now $3.07 per barrel; Lagunillas (heavy) is now $2.38. Middle East Arabian crude (ex Sidon) is now $2.69 and Iraq-Basrah (ex Fao) is now $1.87 per barrel—both ME crudes averaging 36-36.9 gravity.

Indiana Standard Reorganizes

Chairman Robert E. Wilson and president Frank O. Prior of Standard Oil Co. (Ind.) announced that, effective January 31, nine wholly owned affiliates were reorganized into four operating companies to increase efficiency and economy. Crude-oil purchasing activities of three former subsidiaries have been combined into a fifth company. Reorganization is along functional lines. Functions and surviving companies are: oil and gas production—Pan American Petroleum Corp.; eastern and southern refining and marketing—The American Oil Co.; crude-oil pipeline transportation—Service Pipe Line Co.; chemical manufacturing and sales—Amoco Chemicals Corp.; and crude-oil purchases and sales—Indiana Oil Purchasing Co.

Pan American Production Co. (formerly a subsidiary of American Oil Co.) was consolidated into Stanolind Oil and Gas Co., Tulsa, headed by E. F. Bullard. In a supplementary change, Pan American Gas Co. (also former American Oil subsidiary) has become a Stanolind subsidiary. Stanolind Oil and Gas Co. changed to Pan American Petroleum Corp., February 1.

Eastern and southern refining and marketing were consolidated under The American Oil Co., New York, of which D. J. Smith is president. Refining and marketing properties of Pan-Am Southern Corp. (formerly a Standard Oil Refining and marketing subsidiary in six southern states) were transferred to American Oil. Use of the Pan-Am tradename will be continued by American Oil in the area where Pan-Am Southern formerly marketed.

American Oil Pipe Line Co. was merged into Service Pipe Line Co., Tulsa. J. L. Burke continues as president. Pipeline facilities of Pan-Am Southern Corp. were also consolidated into Service.

Chemical manufacture and sales were consolidated under Amoco Chemicals Corp. (formerly Hidalgo Chemical Co.) which had been a Stanolind subsidiary. Indoil Chemical Co. and Pan American Chemicals Corp. were united with Amoco Chemicals. Former Indoil president Jay H. Forrester heads Amoco Chemicals—now a directly owned Standard Oil subsidary, with headquarters in Chicago.

Crude-oil purchases and sales activities (formerly handled by Pan American Production Co., Pan-Am Southern Corp., and Stanolind Oil Purchasing Co. of Tulsa) are to be handled by a new company, Indiana Oil Purchasing Co., with headquarters at Tulsa. R. F. Pielsticker, who headed Stanolind Oil Purchasing, is president of Indiana Oil Purchasing.

Gasoline Octane Numbers Rise

Gasoline on sale in 27 cities in the USA the last week of 1956 had average research octane numbers of 97 or more, according to Du Pont's quarterly motor-gasoline survey released by the company's Petroleum Chemicals Division. The national weighted premium-gasoline octane average was up two-tenths of a number of 97, with the highest premium sample in the country testing 100.3 octane numbers. The national weighted regular figure was 90, up five-tenths of a number. The highest regular sample in the country tested 94.7. The US weighted total pool of both regular and premium averaged 92.2 octane numbers, an increase of five-tenths since the October survey.

What's yours?

NON-FERROUS CASTING is a specialist field in which experience and facilities are all-important. When you require non-ferrous castings . . . for ordinary or extra-ordinary purposes . . . specify BIRSO; you'll get the finest there are. The very best cost no more . . . and may well cost far less in the long run.

CASTINGS FROM A FEW OUNCES TO 10 TONS . . .

in phosphor-bronze, gun-metal, aluminium-bronze, manganese-bronze and light alloys. Precision-machined bushes and bearings. Specialists in high-tensile aluminium-bronze castings, centrifugal-cast wheel blanks, and chill-cast rods and tubes.

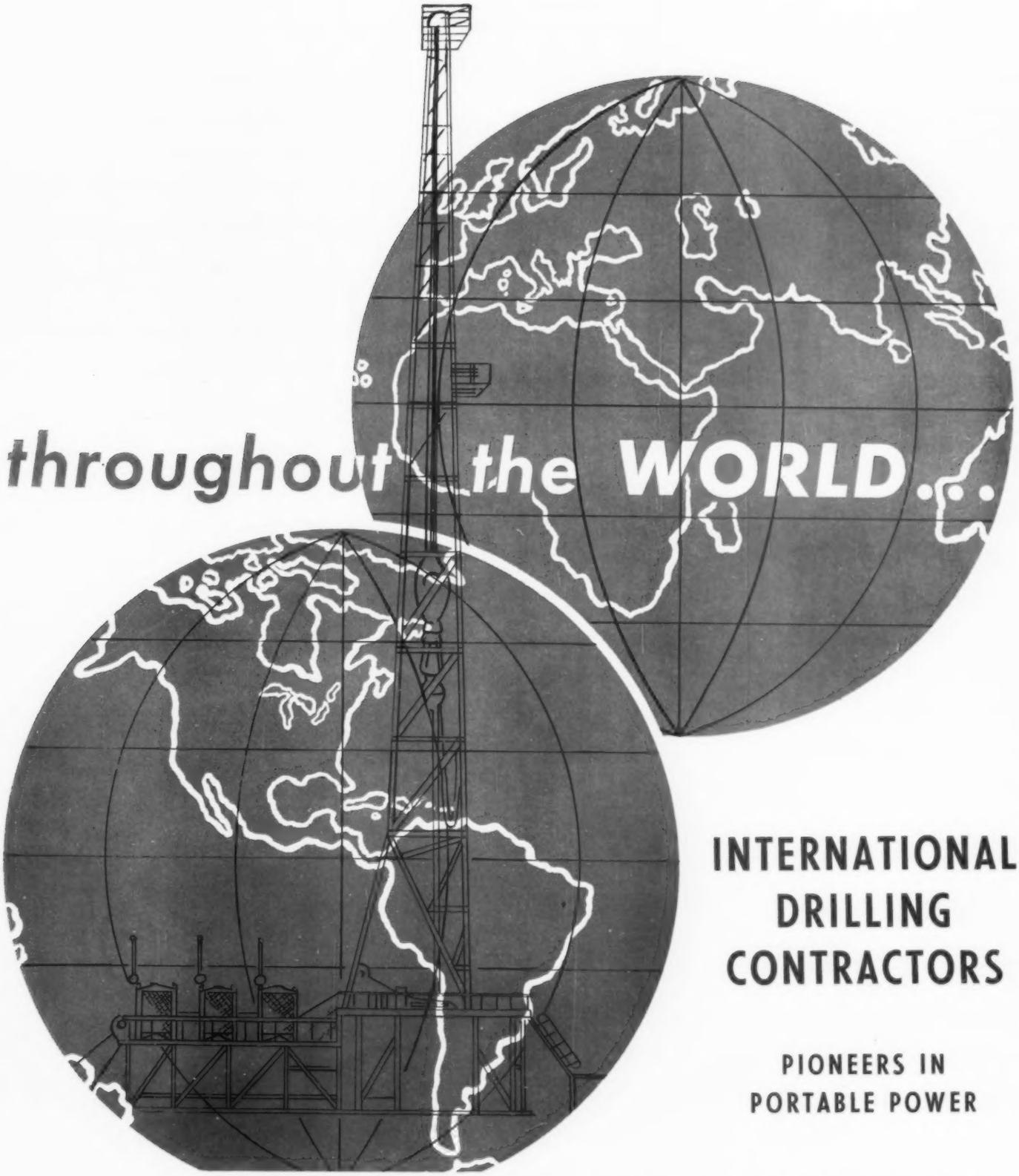
BIRSO TRADE MARK BN

One of Britain's Largest NON-FERROUS Foundries

T. M. BIRKETT, BILLINGTON & NEWTON LTD

HANLEY AND LONGPORT, STOKE-ON-TRENT

Head Office: HANLEY, Phone: Stoke-on-Trent 22184/5/6/7. LONGPORT, Phone: Stoke-on-Trent 87303



throughout the WORLD...

INTERNATIONAL
DRILLING
CONTRACTORS

PIONEERS IN
PORTABLE POWER

BROWN DRILLING COMPANY
LONG BEACH 7, CALIFORNIA
CABLE ADDRESS: BROWNDRIL

ADVERTISERS' INDEX

(Advertising Agencies in Italics)

Air Pumps Ltd. — 103
Goddard Watts Ltd.

John Allen & Sons (Oxford) Ltd. — 137
Howard Bull Advertising

A. E. Ames & Co. Ltd. — 6
MacLaren Advertising Co. Ltd.

Baash-Ross Tool Company — 81
Ruthrauff & Ryan, Inc.

Bell Helicopter Corporation — 141
Baldwin, Bowers & Strachan Inc.

Birkett, Billington & Newton Ltd. — 142
S. C. Peacock Ltd.

The British Ceca Co. Ltd. — 140
Rex Publicity Ltd.

British Oxygen Gases Ltd. — 32
F. C. Pritchard Wood & Partners Ltd.

British Petroleum Company Limited — 91
S. H. Benson Ltd.

British Thomson-Houston Co. Ltd. — 34
Technical & General Adv. Agency

Peter Brotherhood Ltd. — 133
J. Peers & Associates Ltd.

Brown Drilling Company — 143

Burgess Products Co. Ltd. — 110
Gee Advertising Ltd.

The Butterley Company Limited — 23
Scott-Turner & Associates

Camco Products, Inc. — 43
Vincent Pacelli Advertising

The Cape Asbestos Co. Ltd. — 10
Taylor Advertising Ltd.

Chicago Bridge & Iron Co. — 7
Russell T. Gray, Inc.

Clark Brothers Company — 26-27
The McCarty Company Adv., Inc.

Climax Rock Drill & Engineering Wks Ltd. — 146
The Technical Advertising Service

Cochran & Co. (Annan) Ltd. — 110
The Technical Advertising Service

Crane Packing Ltd. — 145
J. Ainsborough Everiss & Associates
Ruddock Advertising Agency

M. J. Crose Mfg. Co., Inc. — 127
Paul Locke Advertising, Inc.

Davison Chemical Co., Div. of W. R. Grace & Co. — 37
St. Georges & Keyes, Inc.

Dawson & Bownie Ltd. — 78

Decca Navigator Co. Ltd. — 129
John Tait & Partners, Ltd.

Dresser Industries, Inc. — 112-113
The McCarty Co. Advertising, Inc.

E. I. duPont de Nemours & Co., Inc. — 17-18
Charles L. Rumrill & Co., Inc.

Electro-Technical Labs. — 38-39
Houston Advertising Agency, Inc.

Equitable Equipment Co., Inc. — 133

Esso Research & Engineering Company — 13
McCann-Erickson, Inc.

Ethyl Corporation — 1
Young & Rubicam, Inc.

Fairchild Aerial Surveys, Inc. — 134
Clyde D. Graham Advertising

Foster Wheeler Corporation — 3
Marsteller, Rickard, Gebhardt and Reed, Inc.

The General Electric Co. Ltd. of England — 87, 120
Kingscott Ltd.

General Geophysical Co., Inc. — 33
Rives, Dyke and Company

Geolograph Company — 133
Lowe Runkle Company

Geophysical Service, Inc. — 115
Auld Advertising

Matthew Hall & Co. Ltd. — 95

Halliburton Oil Well Cementing Co. — 46
Herbert E. Hill Advertising, Inc.

Head Wrightson Processes Ltd. — 79
J. Peers & Associates Ltd.

Herb J. Hawthorne, Inc. — 122
Brennan • McGary • Robinson, Inc.

Houdry Process Corporation — 64
Arndt, Preston, Chapin, Lamb & Keen, Inc.

F. A. Hughes & Co. Ltd. — 99
Lashbrook Advertising

Hughes Tool Company — 35-36
Foote, Cone & Belding, Inc.

Imperial Bank of Canada — 136
McKim Advertising Ltd.

Independent Exploration Company — 12
Aylin Advertising Agency

International Paints Ltd. — 105
Mayfair Advertising Ltd.

International Standard Electric Corporation — 40-41
J. M. Mathes, Inc.

Robert Jenkins & Co. Ltd. — 127
Wm. Hopwood & Co. Ltd.

M. W. Kellogg Company — 19
Fuller & Smith & Ross, Inc.

Ketjen — 130
Raedt en Baet

Koenig Iron Works, Inc. — 128
Bozell & Jacobs, Inc.

Lake & Elliott Ltd. — 114
Ripley Preston & Co. Ltd.

Lucey Export Corporation — 107
Sam J. Gallay Advertising

The Lummus Company — 44
G. M. Basford Company

Magnet Cove Barium Corporation — Cover III
Rives, Dyke and Company

Manning, Maxwell & Moore, Inc. — 9
Fuller & Smith & Ross, Inc.

McCullough Tool Company — 2
Raymond O. Perry Advertising

Mid-Continent Supply Company — 22
Magnussen Advertising Agency

Moon Brothers Ltd. — 114
Donald MacDonald (Advertising) Ltd.

Newman, Hender & Co. Ltd. — 111
Adams Bros. & Shardlow Ltd.

Oil Center Tool Company — Cover IV
Rives, Dyke and Company

The Ralph M. Parsons Co. — 89
Dozier Eastman and Company

Perforating Guns Atlas Corporation — 16
Brinley Advertising Agency

F. Perkins Limited — 42
Crane Publicity Ltd.

Petty Geophysical Engineering Co. — 14
Claude Aniol Associates

Procon Incorporated — 83
Sam J. Gallay Advertising

The Pyrene Company Limited — 28
Nelson Advertising Service Ltd.

Reasor Drilling Company — 8

Rogers Geophysical Company — 25
Rives, Dyke and Company

Ruston & Hornsby Ltd. — 109
Industrial Publicity Service Ltd.

Santa Fe Drilling Company — 124
Dozier Eastman and Company

Scammell Lorries Ltd. — 24
Mayfair Advertising Ltd.

Schlumberger Well Surveying Corporation — 63
Rives, Dyke and Company

Security Engineering Division — 101
The McCarty Company of Texas, Inc.

Seismograph Service Corporation — 131
Watts, Payne—Advertising, Inc.

Shell Oil Company — 30
Kenyon & Eckhardt Inc.

Socony Mobil Oil Company, Inc. — 117
Compton Advertising, Inc.

Southwestern Industrial Electronics Co. — 138-139
Publication Service Company

Peter Spence & Sons Ltd. — 97
Ripley Preston & Co. Ltd.

Standard Oil Co. of Calif. — 15
Batten, Barton, Durstine & Osborn, Inc.

Standard Oil Company (New Jersey) — 93
McCann-Erickson, Inc.

Stewarts & Lloyds Ltd. — 82
H. Raymond Morgan

J. Stone & Co. (Charlton) Ltd. — 119

Stothert & Pitt Ltd. — 87

Texas Instruments Incorporated — 135
Brennan • McGary • Robinson, Inc.

Tidelands Exploration Co. — 118
Bozell & Jacobs, Inc.

Timken Roller Bearing Company — 31
Batten, Barton, Durstine & Osborn, Inc.

Unit Crane & Shovel Corporation — 5
Paulson-Gerlach & Associates, Inc.

United States Steel Export Company — 11
Batten, Barton, Durstine & Osborn, Inc.

Universal Oil Products Company — 20-21
Sam J. Gallay Advertising

Vokes Ltd. — 121
Crane Publicity Ltd.

Warren Petroleum Corporation — Cover II
Chapman Company

G. & J. Weir Ltd. — 120
Scottish Industrial Advertising

Western Geophysical Company — 123
L. J. Swain, Advertising

Williams Brothers — 126
Scot's Advertising

Woodfield Hoist & Associates Industries Ltd. — 125
KS Advertising Ltd.

Worthington Corporation — 4
Gotham-Vladimir Advertising, Inc.

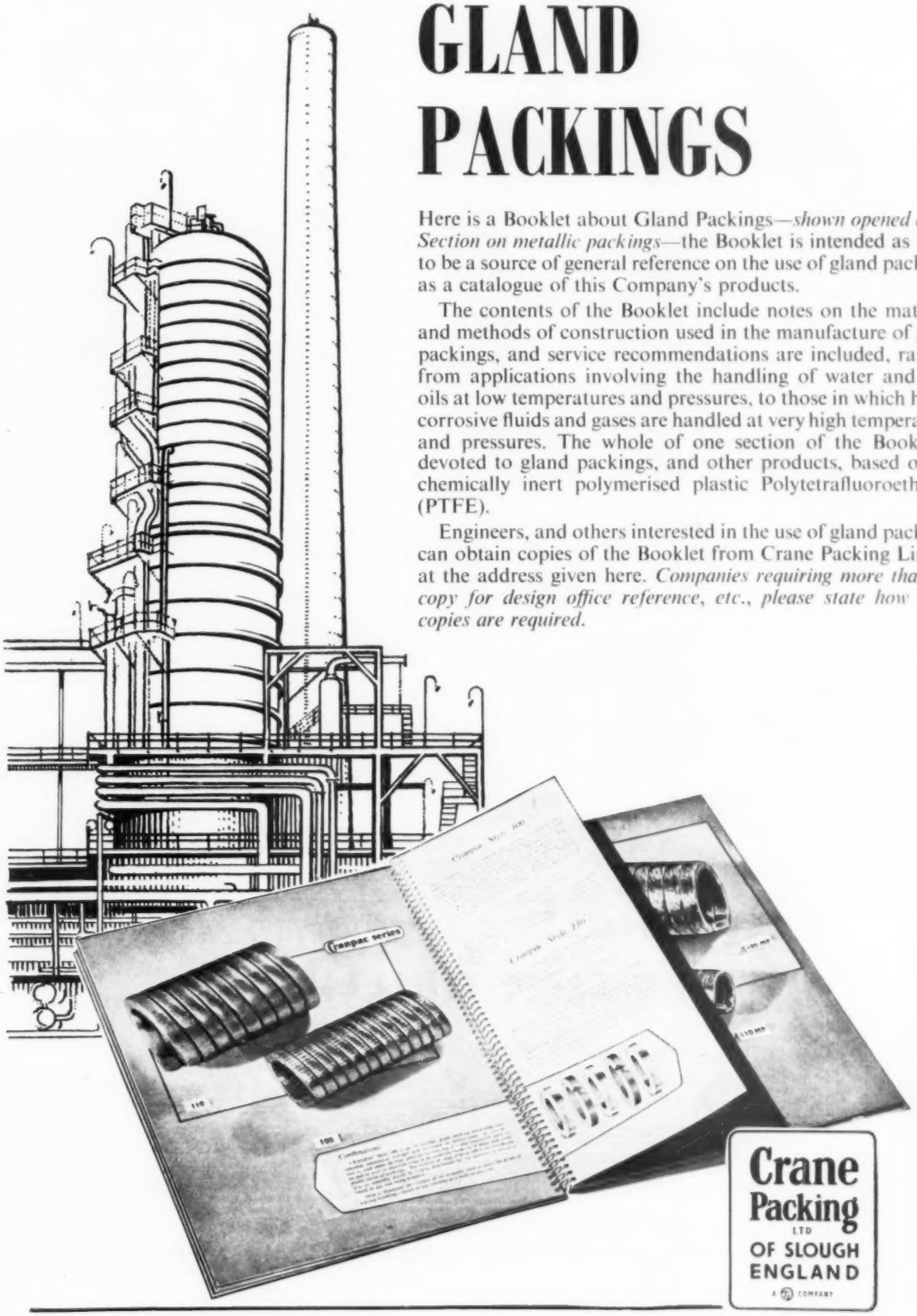
W-S Fittings Div., H. K. Porter Company, Inc. — 29
W. L. Towne Advertising

GLAND PACKINGS

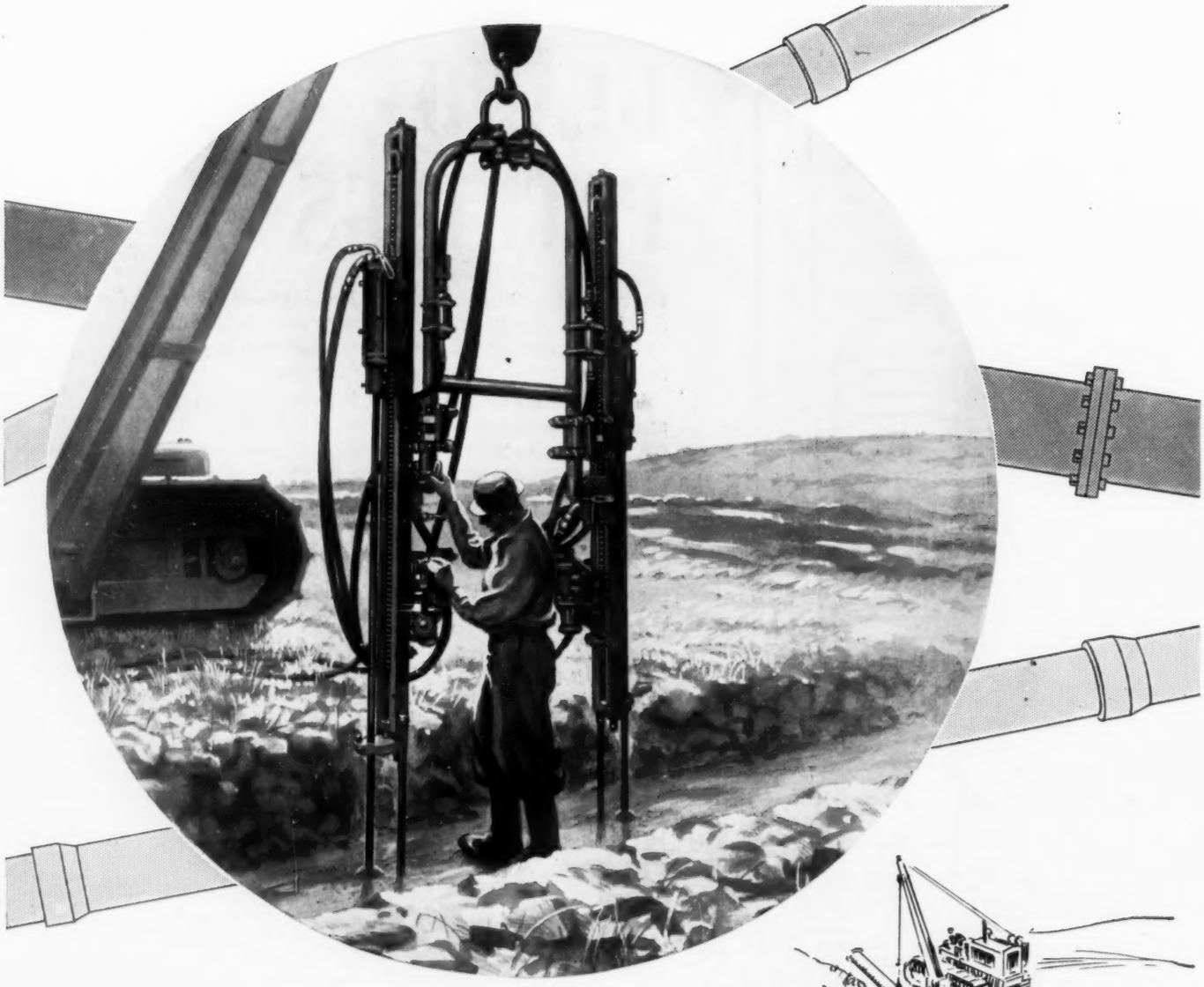
Here is a Booklet about Gland Packings—*shown opened at the Section on metallic packings*—the Booklet is intended as much to be a source of general reference on the use of gland packings, as a catalogue of this Company's products.

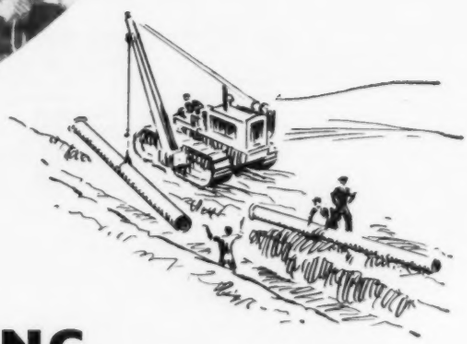
The contents of the Booklet include notes on the materials and methods of construction used in the manufacture of gland packings, and service recommendations are included, ranging from applications involving the handling of water and light oils at low temperatures and pressures, to those in which highly corrosive fluids and gases are handled at very high temperatures and pressures. The whole of one section of the Booklet is devoted to gland packings, and other products, based on the chemically inert polymerised plastic Polytetrafluoroethylene (PTFE).

Engineers, and others interested in the use of gland packings, can obtain copies of the Booklet from Crane Packing Limited at the address given here. *Companies requiring more than one copy for design office reference, etc., please state how many copies are required.*



Crane Packing LTD OF SLOUGH ENGLAND
A COMPANY





NEW ANGLE ON PIPE-LINE DRILLING

Now *two* men can do the work of *fifteen to twenty* men with hand-held drills!
This tough rig, supported by a tracked vehicle, carries two 4-inch
Climax drifters which fairly *sprint* down the holes—and
think what efficient blasting you get with 4″ holes up to 7 feet deep!
Send now for full particulars of this time and labour saving rig,
British made for delivery anywhere in the world.

THE CLIMAX ROCK DRILL AND ENGINEERING WORKS LTD.
CARN BREA, REDRUTH, CORNWALL, ENGLAND.

CLIMAX TWIN-DRILL TRENCH RIG

TAS/CX 615

It takes a complete team to keep dependable drilling mud service available for you

Meet this Magcobar Man, whose construction work assures you of a steady supply of drilling fluids

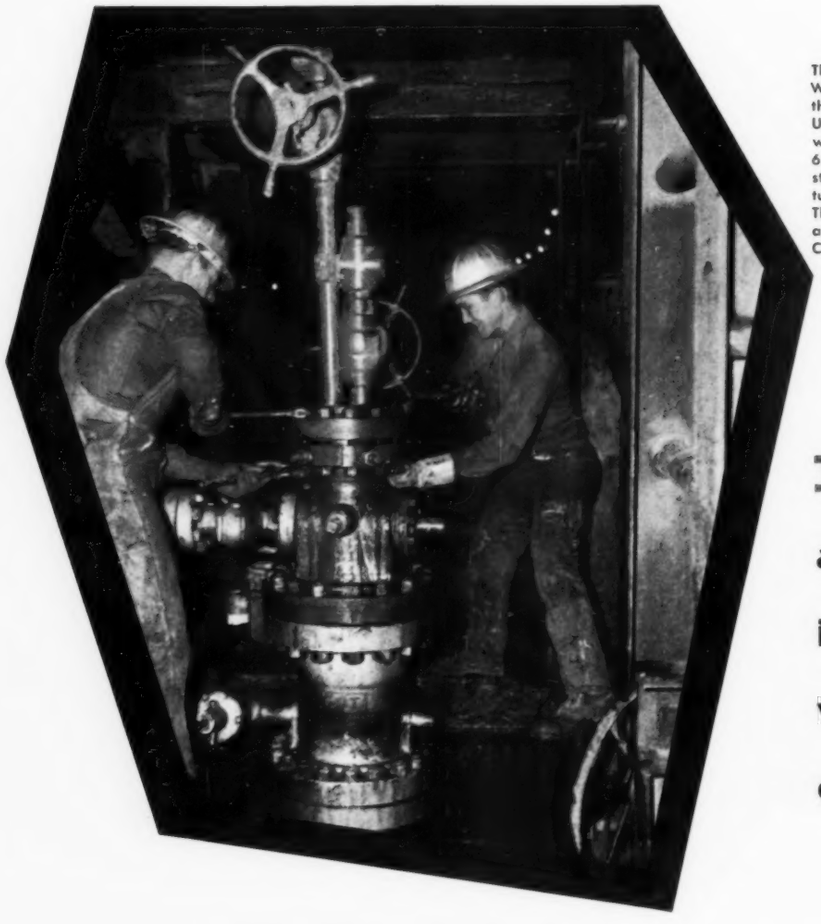
More and deeper drilling and the resulting increase in the use of drilling muds has focused attention on the mining and production of drilling fluid additives. Magcobar, possessor of the industry's largest producing facilities, has accepted this challenge by accelerating its plant construction and expansion program at an ever-increasing pace.

As a result, from Nova Scotia to Mexico, from Greece to Nevada, Magcobar construction supervisors, like this one, are working at plant expansions to assure a continued supply of high quality drilling fluids for the oil industry. These construction specialists are important members of the Magcobar team that provides the most complete drilling mud service in the oil fields.

MAGNET COVE BARIUM CORPORATION

Houston, Texas

Magcobar
Complete
DRILLING MUD SERVICE



This O-C-T Dual String Wellhead Assembly has the new O-C-T Universal Tubing Head which accommodates 6 interchangeable dual string and single string tubing hangers. The foundation is an O-C-T "C-19" Casing Head.

FIRST

and still first... in high pressure wellhead equipment

This O-C-T Dual Completion Tree is only one of many economically important products pioneered by Oil Center Tool Company. It is the result of more than 15 years of continuous improvement in multiple zone completions.

Other O-C-T "Firsts:" the FIRST factory-assembled and tested Christmas Tree . . . the FIRST 10,000, the FIRST 15,000, the FIRST 30,000 pound test Christmas Trees . . . the FIRST casing head with an automatic seal . . . the FIRST and only flow control that gives advantages of both a choke and a valve . . . the FIRST universal tubing head.

When you are ready to complete your next well, turn first to the organization that was first . . . and still first . . . in meeting your present and future needs for dependable high pressure wellhead equipment. You'll be money ahead!

O·C·T

OIL CENTER TOOL CO.
HOUSTON